Abstract Volume

GEOKURDISTAN VI

THE SIXTH INTERNATIONAL GEOLOGICAL CONFERENCE OF KURDISTAN

5-7th NOVEMBER, 2024

SULAIMANI, KURDISTAN REGION-IRAQ

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GEOKURDISTAN VI

The Sixth International Geological Conference of Kurdistan

Abstract Volume

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Sulaimani, Kurdistan Region-Iraq

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In the name of God

Dear participants in the Six International Geological Conference of Kurdistan (GeoKurdistan VI - 2024):

On behalf of the Organizing Committee, the Kurdistan Geology Society, and the Department of Earth Sciences and Petroleum/ University of Sulaimani, I would like to welcome you here and wish you a very pleasant and useful visit to Sulaimani. Also I hope that our meeting will be the continuous working for the development and renewal of geology in Kurdistan and Iraq.

The conference 's objectives are: - to submit and discuss geological research on topics related to Iraq and Kurdistan; to determine the needs of geological studies in the region, and the deficiencies; to promote the participation of geologists from different areas and schools, which will create new ideas; to plan for new collaborative geological projects. Indeed, the success of this conference will be dependent on your presentations, to be given here in the next couple of days. Our hope is that this meeting will become a systematic annual tradition, to be held every year.

I extend my gratitude to the University of Sulaimani and our collaborative partner, the Kurdistan Geology Society, for their unwavering support in organizing this esteemed conference.

It is my pleasure to thank all our sponsors; the Halabja Group, Bareaz Group, and Kurdistan Institution for Strategic Studies and Scientific Research, who faithfully support the conference financially. Welcome again, and have a wonderful stay in Sulaimani.

Ibrahim M.J. Mohialdeen

Chairman of the organizing committee

GeoKurdistan VI- 2024

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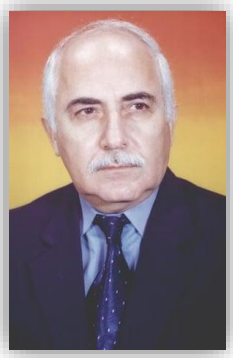
James Lawrence	Senior Lecturer - Geotechnics	Faculty of Engineering, Department of Civil and Environmental Engineering, Imperial College of London

Keynote Speakers:



Dr. Khaldoun S. Al-Bassam

- Chief Scientific Researcher in Earth Sciences,
- Former Director General of Iraq Geological Survey
- Consultant at the University of Technology, Baghdad.

https://iq.linkedin.com/in/khaldoon-al-bassam-ba06a290

https://www.researchgate.net/profile/Khaldoon-Al-Bassam

albassam703@gmail.com

Mineral resources of Kurdistan region, Iraq: an overview

Abstract

Kurdistan Region is characterized, among the rest of Iraqi territory, by the presence of metallic mineral deposits such as Zn, Pb, Cu, Cr-Ni and Mn, together with some unique non-metallic minerals and industrial rocks such as barite, asbestos and marble. The formation of these mineral deposits is associated with the geological and tectonic development of northern Iraq including the major tectonic events associated with the Tethys development and movement of the Arabian Plate. Kurdistan Region is characterized by endogenic metallic mineralization of Triassic – Jurassic, Late Cretaceous, and Paleogene age. It includes mineralization of magmatic, hydrothermal, metamorphic and sedimentary origins, which may be related to regional orogenic phases. The mineralization in Kurdistan Region was affected by two metallogenic periods related to regional (continental) tectonic events associated with the development of the Neo-Tethys. The first is the Late Triassic – Jurassic, which gave rise to the strata-bound Zn-Pb mineralization in the Triassic carbonates. The second is the Late Cretaceous, which developed the Cr, Ni and Cu-bearing basic and ultrabasic complexes of the Zagros Suture Zone and the formation of the vein and strata-bound, low-temperature Zn-Pb – barite – pyrite – siderite mineralization in carbonates of Cretaceous age in the Imbricate Zone. The mineral deposits and occurrences known in Kurdistan Region represent the findings of intermittent exploration works carried out since the early fifties of the past century. They do not represent the full mineral potential of the region in any way. It is expected that Kurdistan Region contains more mineral resources, which need to be explored and evaluated. The discontinuous nature of the geological works in the past and the lack of air-born surveys and the limited geochemical surveys in this interesting minerogenic province have delayed the accurate assessment of the full potential of the mineral resources in the region. The actual mineral wealth of Kurdistan Region is not really known. However, based on the available

information it is expected that the province is promising for Zn, Pb, Cu, Cr, marble, barite and possibly radioactive mineral deposits. Building raw materials are available to maintain cement and other construction material industries. It is essential to start a comprehensive exploration program in Kurdistan Region in order to assess its full mineral potential.

Dr. Ondřej Bábek

- Professor at Department of Geology, Palacký University, 17. listopadu 12, Olomouc 77146, Czech Republic.

E-mail: ondrej.babek@upol.cz

Phone: +420 585 634 532

https://www.researchgate.net/profile/Ondrej-Babek

geology.upol.cz I petroleum.upol.cz

ondrej.babek@upol.cz

Continental red beds, and old concept but questions remain: how, why, and when red, and why should we bother?

Abstract

Continental red beds (CRB) are distinct facies, which have attracted the interest of geologists for about two centuries. They have been traditionally interpreted as time-specific facies, and indicators of arid desert climate especially in the Permian to Triassic periods. In fact, CRBs can develop in various types of depositional environments, not only in arid settings, and they are known from various time periods from the Proterozoic to Recent. But when it comes to a precise definition of CRBs, how red is actually "red" (?), what processes of mineral transformations are involved in the reddening (?), when did these processes occur (?) how are they reflected in chemistry of sedimentary rocks (?), and did they really reflect ancient climates? We will address these questions using rigorous colour quantification by diffuse reflectance spectroscopy, combined with the methods of field facies analysis, gamma-ray spectrometry, sandstone and mudstone petrography, major and trace element geochemistry, in-situ element geochemistry in thin sections, and molybdenum isotopes. We will discuss case studies encompassing the famous Old Red Sandstone (Lower Devonian) of South Wales, Variscan intramontane basins of Bohemian Massif (Permian), Czech Republic, continental sediments of the Colorado Plateau, Utah, USA (Permian to Jurassic), red sediments of the Gercus Formation from the Zagros Foreland, Kurdistan Region of Iraq (Eocene), and Holocene fluvial sediments of the Czech Republic.

Program of GeoKurdistan VI

Day 1 Tuesday 5th November 2024

09:00-10:00 Registration

10:00-10:30 Welcome Speech

10:30-11:00 **Keynote speaker: Dr. Khaldoun S. Al-Bassam**

11:00-11:30 Coffee break and Poster session

11:30-13:10 Session 1

13:10-14:30 Lunch

14:30-16:30 Session 2

Day 2 Wednesday 6th November 2024

09:00-09:30 **Keynote speaker: Dr. Ondřej Bábek**

09:30-11:30 Session 3

11:30-12:00 Coffee break and Poster session

12:00-13:00 Session 4

13:00-14:00 Lunch

14:00-16:00 Session 5

16:00-16:30 Closing session

Day 3 Thursday 7th November 2024 (Field Trip)

07:30 Departure from the Hotel by Bus

14:30 Lunch

Day 1 (5/11/2024)							
09:00 - 10:00	Registration						
Opening session							
10:00-10:30	Welcome Speech						
10:30-11:00	Keynote Speaker: Dr. Khaldoun S. Al-Bassam (MINERAL RESOURCES OF KURDISTAN REGION, IRAQ: AN OVERVIEW)						
11:00-11:30	Coffee break						
	Hall 1		Hall 2		Hall 3		Hall 4	
Session 1	Chair: Khaldoun.S. Alfarisi	Secretary: Shadan M. Ahmed	Chair: Bakhtiar Qader Aziz	Secretary: Huda F. Rafea	Chair: Younus I. Al-Saady	Secretary: Farhad Ahmed Mohammad	Chair: Twana O. Abdullah	Secretary: Azad Sangawi
11:30-11:50	**GK6-8** 3D Porosity Modeling of Albian-Cenomanian Tight Carbonate Reservoir in West Qurna 1 Oilfield **Maysaa A. Abdulhameed,Fahad M Al-Najm, Maher M Mahdi Rafea, Ahmed Abdullah**		**GK6-32** Seismic Expression of Karst-Related Features and 3D Seismic Evidence of the Effects of Carbonate Karst Collapse and Fault System on hydrocarbon migration path in Merjan-West Kifl Oil Fields, Center of Iraq **Ali M. Al-Rahim, Mohammed Sadi Fadhel**		**GK6-38** STABLE ISOTOPE COMPOSITION AND PETROGRAPHY OF DOLOMITE FROM JERIBE FORMATION, EASTERN IRAQ, ORIGIN AND FORMATION TEMPERATURE **Mustafa A. Ali, Sa'ad Z. Al-Mashaikie, Youns I. Al-Saady**		**GK6-30** Groundwater assessment and selecting appropriate recharge method in the Erbil sub-basin, northern Iraq **Jumaa K. Mohammad Al-Shwani, Sabbar A. Saleh,Diary A. Mohammed Amin Al-Manmi**	
11:50 -12:10	**GK6-26** Geochemical Characterization and Mechanism of Tar Mats in The Zubair Formation, West Qurna Oil Field, Southern Iraq **Haneen M. Abd aali, Amna M. Handhal, Basim H. Soltan**		**GK6-36** Variations of the seismic b- constant value along the Bitlis – Zagros Belt in Iraq and surrounding regions **Emad A. Al- Heety, Huda F. Rafea**		**GK6-53** Geochemistry of Trace and Rare Earth Elements in Different Topsoil of Lesser Zab River Basin, Kurdistan Region, Northeast Iraq **Younus I. Al-Saady, Arsalan Ahmed Othman, Salahalddin S. Ali, Yousif O. Mohammad, Ahmed K. Obaid, Veraldo Liesenberg, Syed E. Hasan**		**GK6-102** Evaluation of Groundwater Flow Model in Bashtapa Sub-basin, Erbil, Northeast of Iraq **Sarkhel H. Mohammed, Yetzabbel Flores, Viktoria Mikita, Balazs Kovacs, Diary A. Mohammed Al Manmi, Peter Szucs**	
12:10-12:30	**GK6-33** Petrophysical Interpretation of Unconventional Carbonate Sargelu Reservoir in Ajeel Oil Field **Khaldoun.S. Alfarisi, Abeer Tariq, Mohammed.S. Aljawad**		**GK6-37** GPR characterization of buried soil subsidences: using synthetic model and field data **Hussein Abdulrahim Al-Saady**		**GK6-71** Petrography and Geochemistry of Injana formation in selected sections , North-eastern Iraq: Implications for provenance and tectonic setting **Sattar J. AL-Khafaji and, Nael Al-Najaari**		**GK6-116** Geospatial Modeling of groundwater potential zones using multi-parameter decision analysis supported by electrical resistivity tomography in New Halabja District, NE-Iraq **Hawber Ata Karim, Sarkhel H. Mohammed, Bakhtiar Qdir Aziz, Diary Ali Mohammed, Peter Szucs**	
12:30-12:50	**GK6-34** BUILDING A 3D GEOLOGICAL MODEL OF KURRACHINE FORMATION IN Alan OIL IN NOTHERN PART OF IRAQ **Khaldoun.S. Alfarisi, Mohammed.S. Aljawad**		**GK6-66** The importance of 2D Electrical Resistivity Imaging (ERI) at a pre-engineering construction site in Duhok, Iraq **Kaheen D. Bamerni, Alfred Mansour, Rashied J. Mohammad**		**GK6-82** Mineralogical and Geochemical Study of Quaternary Deposite at Al-Khora region in Basrah Governorate / Southern Iraq **Khaleel J. Al-Sudani, Ajel S. Y. Al-hadadi**		**GK6-130** Groundwater Potential Mapping Using Geospatial Approaches Combined with Electrical Resistivity Tomography in Bazian Basin, Sulaymaniyah City, Iraqi Kurdistan Region **Hawber Ata Karim, Zana Rughzai, Azad Sangawi, Bakhtiar Qader Aziz**	
12:50-01:10	**GK6-35** FRACTURE DESIGN OF AN UNCONVENTIONAL MUS OIL RESERVOIR IN Taq-Taq OIL-GAS FIELD Khaldoun.S. **Alfarisi, Adnan Ajam, Mohammed.S. Aljawad**		**GK6-72** Exploration of clay layers as a raw material for cement production from Quaternary sediments using 2D Electrical Resistivity Imaging, Mineralogical, and Geochemical Investigations in both Bazian and Takya areas, Kurdistan Region, NE Iraq **Bakhtiar Qader Aziz, Hawkar Omer Hamaamin, Omer Ahmed Rashid, Rezhan Raoof Osman, Rezhan Jamel Mohammad**		**GK6-104** Geochemical comparison between the carbonates of Pila Spi Formation and those of Conglomerate unit separating it from Gercus Formation, Kurdistan Region northeastern Iraq **Farhad Ahmed Mohammad**		**GK6-132** Statistics Analysis for the hydrochemical parameters of Euphrates River between Musayab and Al-Hindya\ Middle part of Iraq **Alyaa SH. Oleiwi, Qusai Y. Al-Kubaisi, Alhassan H. Ismail**	
Lunch								

	Hall 1		Hall 2		Hall 3		Hall 4	
Session 2	Chair: Varoujan K. Sissakian	Secretary: Hamid Hakiminezhad	Chair: Sherzad Tawfiq	Secretary: Abdulrahman Bamerni	Chair: Aref Shamszadeh	Secretary: Irfan Sh. Asaad	Chair: Dler H. Baban	Secretary: Hiwa H. Mohammed
02:30-02:50	**GK6-2** The Role of Alluvial Fans in Diverting Valleys' Trends. Qash Qooly Stream. A Case Study from Iraqi Kurdistan Region **Varoujan K. Sissakian, Lanja H. Abdullah, Balanbo N. Abdulkareem, Iyda D. Abdulahad**		**GK6-5** Sedimentology and Depositional Environment of Injana Formation's Sandstone Member, Kurdistan Region, Iraq **Rzger A. Abdula, Mohammad Sadi Nourmohamadi, Bzhar A. Delizy, Idrees Nadir Ahmed**		**GK6-25** A geological study of the Busaiya sub-basin structure covering part of the stable Arabian Platform in SW Iraq using geophysical and satellite data. **Hayder A. Al-Bahadily, James D. Fairhead, Hanbing Ai, Younus I. Al-Saady, Yasir F. Shyaa**		**GK6-41** Strategic Drilling Decisions Based on Seismic Fault Inclination Analysis for Enhancing Hydrocarbon Recovery in Bijeel and Harir Oil Fields Kurdistan Region **Mahdi Khairi Aswad, Shokhan Azad, Helin Mohammed**	
02:50-03:10	**GK6-12** Using OIP Factor to determine of band combination Landsat Image data, a case study of site in NE Iraq **Talal Hassan Kadhem**		**GK6-54** Microfacies and Depositional Environment of (Lower Cretaceous) Balambo Formation in selected area, Imbrication Zone, Northeastern Iraqi Kurdistan Region **Aheen O. Abdullah, Sardar M. Balaky**		**GK6-29** Sequence of fold evolution within the Low Folded Zone of the Western Zagros Fold-Thrust Belt of Iraq **Saffa F.A. Fauad, Arsalan A. Othman, Ahmed K. Obaid, Salim Hasan Sulaiman Al-Hakari**		**GK6-58** Log Permeability and ILT comparison, Upper Shale Member at Rumaila Oilfield as case study **Muslim M. Al-Ali, Uday Alshawi, Safaa Majed Aladab, Maher M. Mahdi**	
03:10-03:30	**GK6-42** Machine Learning for Electrofacies Identification in Nahr-umar Reservoir, Majnoon Oil Field **Ala'a A. Al-Malki, Safaa M. Abdulkareem, Mohammed A. Abbas, Watheq J. Al-Mudhafar**		**GK6-60** Provenance of Dune Field Sediments by Studding Heavy Minerals in Al- Najaf area, central Iraq **Mohammed L. Hussein, Mohanad R. A. Al-Owaidi, Hamid A. A. Alsultan**		**GK6-55** Studying Geological Structures and Basement Depth Using Gravity, Magnetic, and SRTM Data for the Al-Jazira Area, NW Iraq **Ahmed S. Mousa, Hayder A. Al-Bahadily**		**GK6-62** Reservoir characterization of the Late Campanian and Maastrichtian Shiranish Formation, Kurdistan Region, Iraq **Basoz J. Salih, Hussein S. Hussein, Omer Th. Taher**	
03:30-03:50	**GK6-52** Ancient shoreline delineation using subsurface data and remote sensing techniques: A case study in the Arabian Gulf **Arsalan Ahmed Othman, Salahalddin S. Ali, Ahmed K. Obaid, Younus I. Al-Saady, Mustafa Ali, Maher M. Mahd, Hasan Kattoof Jasim**		**GK6-61** Stratigraphy and Microfacies analysis of the lower Miocene Euphrates Formation: A new record from the Duhok area, northern of Iraq **Abdulrahman Bamerni, Ashti Barzani, Arkan Sharazwri**		**GK6-98** Morphotectonic Indices of Some Geological Structures -Northern Iraq **Alaa N. Hamdon, Rabeea Kh. Znad, Hadeer Gh. M. Adeeb, Mohammad F. O. Khattab**		**GK6-87** Determining the Best Productive Horizons in the Heavy Oil Content Hartha Formation from a Selected Well in the X Oilfield in Northern Iraq Using Wireline Log Data **Dler H. Baban, Ayub M. Ahmed Shwani, Qays M. Sadeq, Shadan M. Ahmed, Sabir S. Barzanji**	
03:50-04:10	**GK6-81** Improvements to Permeability Prediction by Data Fusion models and Deep Learning with OWA Operators **Hamid Hakiminezhad, Behzad Moshiri, Golnaz Jozani Kohn**		**GK6-99** Stratigraphy, sedimentology and source rock evaluation of the Baluti Formation, Sirwan Gorge and Kaolos area, Kurdistan Region NE Iraq **Sirwan H. Ahmed, Asaad I. Mustafa, Barween O. Qade, Ibrahim M. J. Mohialdeen, Polla A. Khanaqa**		**GK6-111** Effect of deep-seated structural elements in the basin evolution and petroleum system of the Mesopotamian Zagros Foreland basin **Aref Shamszadeh, Artabaz Adhamian, Iraj Abdollahie Fard, Maryam Jamalian, Ali Asaadi, Behzad Soltani**		**GK6-88** Oil-Oil and Oil-Source Correlation of Crudes and Source Rock Extracts from Selected Wells and Outcrops in the Southern Part of the Iraqi Kurdistan Region **Dler H. Baban, Shadan M. Ahmed**	
04:10-04:30	**GK6-84** RELATIONSHIP OF LST, NDVI AND NDBI USING LANDSAT 5, 8 AND SENTINEL 2A DATA IN BAGHDAD CITY **Sarmad.H. Mahal, Asma'a A.Hamead**		**GK6-50** Porosity Evolution of the Qamchuqa Formation, Early Cretaceous succession in Northeastern part, Iraq **Afnan Al-Zubadi, Zubaida Al-Anbaky, Abdalratha Mohammed**		**GK6-120** Diagenetic impact on porosity types of Middle-Late Eocene carbonate rocks aquifer (Pila Spi Formation) in Bjeel area, High Folded Zone, Iraqi Kurdistan region **Irfan Sh. Asaad, Mohammed salih M. Hassan, Saeed I. Hussain**		**GK6-89** 3D Static Geological Modeling for the Tertiary Reservoir in the Main Southern Dome of the Ajeel Oilfield, Northern Iraq **Sabir S. Barzanji, Dler H. Baban, Muhana M. Ahmed, Kanaan A. Jasim**	

Day 2 (6/11/2024)						
09:00-09:30	Keynote speaker: Dr. Ondřej Bábek (CONTINENTAL RED BEDS, AND OLD CONCEPT BUT QUESTIONS REMAIN: HOW, WHY, AND WHEN RED, AND WHY SHOULD WE BOTHER?)					
	Hall 1		Hall 2		Hall 3	
Session 3	Chair: Dara Faeq Hamamin	Secretary: Shevan Jameel Jirjees	Chair: Ghafor A. Hamasur	Secretary: Kaiwan K. Fatah	Chair: Fadhil A. Ameen Lawa	Secretary: Helbeen Muhammed Abdulwahid
09:30-09:50	**GK6-134** Risk Intensity Mapping of Complex Aquifer Systems Using the Phosphate-DRASTIC-LU Model: Insights from the Penjween Basin, Kurdistan Region, Iraq **Rebar Aziz Qaradaghy, Dara Faeq Hamamin, Diary Ali Al-Manmi**		**GK6-40** Engineering and Structure Analyses of Rock Slope Stability for Selected Sites at Sartaq Area \ Sulaymaniyah Governorate \ Northern Iraq **Manal Shaker Al-Kubaisi, Thair Thamer Al-Samarrai, Aya Ali hameedAya Ali hameed**		**GK6-10** Late Jurassic sequence stratigraphy and hydrocarbon potential in S. Iraq, N. Kuwait, and SW Iran **Hussein Shwayel Aoudah**	
9:50-10:10	**GK6-136** Deciphering geospatial modeling of groundwater potential zones using integration of geostatistical and geophysical approaches in Sulaimani basin, NE of Iraq **Sarkhel H. Mohammed, Hawber Ata Karim, Diary A. Mohammed AL-Manmi, Bakhtiar Qader Aziz, Asaad I Mustafa, Péter Szűcs**		**GK6-69** Evaluation of gypsiferous soils and their geotechnical properties in Kalar, Kurdistan Region, Iraq **Ali Uromeihy, Avesta Mohammad, Mohammad Fathollahy, Bestun Jumma**		**GK6-13** Lithostratigraphy and Microfacies Analysis of the Govanda Formation (Early-Middle Miocene) in Sherwan Mazin area, Kurdistan region, NE of Iraq **Arkan O. Sharazwri, Bzhar. A. Delizy**	
10:10-10:30	**GK6-19** Climate Data Analysis and Drought Index from Sulaimaniyah Area, Iraqi-Kurdistan Region **Masoud Hussein Hamed, Shevan Jameel Jirjees, Kaiwan Krremkhan, Rebar Tahseen, Rebwar Dara**		**GK6-86** Kinematic and Geological Strength Index-slope (GSI-slope) Application for Stability Evaluation of the Rock Slopes along Old Azmer Road in a Part of Azmer Anticline, Sulaimaniyah, NE-Iraq **Ghafor A. Hamasur, Salim H. Sulaiman, Fahmy O. Mohammed**		**GK6-20** Stratigraphy of the South Caspian Basin: Insights from Offshore and Onshore Wells and Outcrops in Turkmenistan and Iran **Arzu Javadova**	
10:30-10:50	**GK6-75** Assessment of Air Contamination in Mosul University Campus using Remote Sensing and GIS Techniques **Alaa N. Hamdoon, Sabah H. Ali, Abdalrahman R. Qubaa, Hikmat Subhi Al-Daghistani**		**GK6-92** Satellite-derived Shallow water depths based on remote sensing and Artificial Intelligence Models: A case study in Darbandikhan Lake, Kurdistan Region, Iraq **Arsalan Ahmed Othman, Salahalddin S. Ali, Ahmed K. Obaid, Sarkawt G. Salar, Omeed Al-Kakey, Ahmed T. Shihab, Younus I. Al-Saady, Veraldo Liesenberg, Silvio Luís Rafaeli Neto, Fabio Marcelo Breunig, Sayed Hasan**		**GK6-31** Revealing for the first time of Calpionellids in the Yamama Formation at the Rumaila Oil Field in Southern Iraq **Rana T. Al-khaya, Maher M. Mahdi, Sany E. Hannina, Muslim M. Al-Ali**	
10:50-11:10	**GK6-85** Using Spectroscopy Regression Analysis to Predict hydrocarbon in Soil around the North Rumaila Field, Southern Iraq **Zahraa A. Khaleel, Auday H. Shaban, Ali A. Al Maliki**		**GK6-109** IMPLICATIONS OF TECTONIC ACTIVITY ON ALLUVIAL FAN'S MORPHOMETRY: A CASE STUDY IN THE NORTHEASTERN DOKAN LAKE, KRG_IRAQ **Hekmat Subhi Yousif Al-Daghastani, Lanja Hossain Abdulla, Azhar Khaleel Sulaiman**		**GK6-100** Biostratigraphy of the Aaliji Formation (Danian stage), Duhok Governorate, Kurdistan Region, North Iraq **Helbeen Muhammed Abdulwahid, Zaid Abdulwahab Malak**	
11:10-11:30	**GK6-117** Comparative study of metal contamination and ecotoxicology in soils near Sisak ironworks (Croatia) and Sulaimani steel plant (Kurdistan Region, Iraq) **Željka Fiket, Ivan Antičević, Marta Popović, Antonela Blažević, Maja Ivanić, Neda Vdović, Roshna A. Hamarashid, Ibrahim M. J. Mohialdeen**		**GK6-123** Geoinformatics-Based Automated Landform Classification and Analysis of Their Relationship with Landslide Susceptibility in Akre District, Kurdistan Region, Iraq **Kaiwan K. Fatah, Rebar T. Mzuri**		**GK6-121** Sequence stratigraphy of two major incised valleys from the Upper Cretaceous / Cenozoic successions within Kurdistan Foreland Basin. Iraq **Fadhil A. Ameen Lawa, Heshw Ahmed Qadir, Nagham Omar**	
Coffee break						

	Hall 1		Hall 2		Hall 3	
Session 4	**Chair: Hawkar Bapir**	**Secretary: Salar S. Hasan Al Karadaghi**	**Chair: Fouad M. Qader**	**Secretary: Sardar S. Fatah**	**Chair: Salim Hasan Sulaiman**	**Secretary: Shahra O. Abdalla**
12:00-12:20	**GK6-79** UNIFIED EARTHQUAKE CATALOG OF IRAQ AND ITS NEIGHBORING REGIONS **Sangar Ali Ahmed, Rami Ibrahim, Basoz Ali, Fadhil I. Khudhur, Hafidh A. Ghalib**		**GK6-122** Characteristics of the Shiranish Formation from Shewashan and Bazian Oilfields in Kurdistan Region, NE Iraq **Danyar A. Salih, Fouad M. Qader**		**GK6-18** Geochemical evidences for paleodepositional conditions of Garagu Formation, Gara Anticline, Kurdistan, northern Iraq **Ibrahim M. J. Mohialdeen, Tola A. Mirza, Farhad Ahmadnejad, Shahra O. Abdalla**	
12:20-12:40	**GK6-118** The effect of basement relief on the shallow structures and courses of rivers in Mesopotamian zone, southern part of Iraq **Laith Sabah Abd, Ali Mali Al-rahim**		**GK6-124** Lateral variations in the reservoir properties of the Middle Miocene Jeribe Formation in the Allas Dome of the Hamrin Oil field, Northern Iraq **Dler H. Baban, Muhamad B. M. Saeed**		**GK6-106** Geochemical characteristics of the Lower and Upper Triassic carbonates from Mirga Mir and Baluti formations, Kurdistan Region, Iraq **Faraj Habeeb Tobia, Baran Hassan Mustafa, Ahmid Mohammed Aqrawi**	
12:40-01:00	**GK6-137** The relation of recorded velocity behaviour with geological formations thickness in Iraq **Salar S. Hasan Al Karadaghi**		**GK6-126** Reservoir characterization of Sarmord Formation from selected wells in Kirkuk and Khabbaz oil fields, Kirkuk, northern Iraq **Shabaz M. Ali, Danyar A. Salih, Sardar S. Fatah, Basim Al-Qayim, Ibrahim M.Mohialdeen**		**GK6-128** Geometric analysis of the Khweelen anticline from the Western Zagros Fold Thrust belt in Kurdistan Region (N.). Iraq) **Adil Omer Abdulla, Salim Hasan Sulaiman (Al-Hakari), Fadhil Ahmed Ameen Lawa**	
Lunch						
	Hall 1		**Hall 2**		**Hall 3**	
Session 5	**Chair: Behzad Soltani**	**Secretary: Heba S. Al-Mimar**	**Chair: Twana A. Mustafa**	**Secretary: Amna N. Al-Amery**	**Chair: Khalid. M. Ismael**	**Secretary: Soran O. A. Kharajiany**
02:00-02:20	**GK6-90** Productivity assessment for the Unit A of the Upper Triassic Kurra Chine Formation from the well BB-4, Bina Bawi Oilfield, Iraqi Kurdistan Region **Dler H. Baban, Mustafa M. Ahmad**		**GK6-21** The Application of Staged Factor Analysis (SFA) Method in Geochemical Anomaly Separation, Case study of Shahrak-e-Rabat area, Northwest Iran **Golnaz Jozanikohan, Mohsen Nosrati Abarghooei, Shahram Shariati, Minoo Ghanbarzad**		**GK6-63** Systematic Taxonomy of exceptionally well-preserved Planktic Foraminifera from the Oligocene, Sangaw area, Kurdistan Region, NE- Iraq **Imad M. Ghafor, Pshtiwan M. Ahmad**	
02:20-02:40	**GK6-96** The discrimination of paleo-exposure surfaces at the Sarvak Formation in the Abadan plain oil fields: An integrated approach **Ali Asaadi, Javad Honarmand, Ali immandoust, Aref Shamszadeh, Behzad Soltani**		**GK6-22** Mineralogy, geochemistry and oxygen isotope of iron mineralization from northeastern Iraq- Gallala area with implications on their genesis. **Twana A. Mustafa, Tola A. Mirza, Stavros P. Kalaitzidis, Shara O. Abdalla**		**GK6-138** Middle Oligocene-Early Miocene Red beds in the High Folded Zone of Kurdistan, Iraq **Soran O. A. Kharajiany**	
02:40-03:00	**GK6-108** Petroleum hydrodynamic of oilfields in Basrah, Southern Iraqi **Heba S. Al-Mimar, Salih M. Awadh**		**GK6-27** PETROGENESIS OF WALASH VOLCANICS FROM MAWAT AREA, IRAQI KURDISTAN REGION **Tola A. Mirza, Jabbar M. A. Qaradaghi**		**GK6-14** Progress in Maastrichtian planktic foraminiferal paleoecology, and implications for paleogeography reconstructions, Kurdistan Region, Northeastern Iraq **Imad M. Ghafor, Ibrahim M. J. Mohialdeen, Asaad I. Mustafa, Howri Mansurbeg**	

03:00-03:20	**GK6-110** Identification of Sequence Stratigraphic Surfaces Using Petrophysical Logs: Implication for Petroleum System Elements; Case Studies from Siliciclastic and Carbonate Oil/Gas Reservoirs in Iran **Behzad Soltani, Reza Mousavi-Harami, Ahmad Reza Rabbani, Ali Asaadi, Aref Shamszadeh**	**GK6-28** Geochemical characteristics of the sedimemts along the Shatt-Alarab and Shatt Al-Basrah rivers bank **Amna N. Al-Amery, Harith A. AlSaad, Haider M. Jaffar**	**GK6-15** Benthic Foraminiferal Assemblages from the Naopurdan Limestone Unit (Eocene), Sulaimaniyah, Kurdistan Region, NE-Iraq **Imad M. Ghafor, Hemn F. Muhammad**
03:20-03:40	**GK6-119** Evaluation of Heat Generation by Radioactive Elements in Jurassic and Cretaceous Successions of the Zagros Belt, Northern Iraq **Fouad M. Qader**		**GK6-16** Biostratigraphy of the Kolosh and Khurmala formations, Dhock area North Iraq **Noor Al Taee, Imad M. Ghafor, Ali Ismail Al Juboury**
03:40-04:00			
04:00-04:30	**Closing session**		

GK6- 2

The Role of Alluvial Fans in Diverting Valleys' Trends. Qash Qooly Stream. A Case Study from Kurdistan Region, Iraq

Varoujan K. Sissakian[*1], Lanja H. Abdullah[2], Balanbo N. Abdulkareem[3] and Iyda D. Abdulahad[4]

[1] Chief Researcher, Petroleum Engineering Department, Komar University of Science and Technology, Sulaimani, 46001, Kurdistan Region, Iraq
[2] Assistant professor, Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Sulaymaniyah, Iraq
[3] Sulaimaniyah Oil and Mineral Directorate, Ministry of Natural Resources, Sulaymaniyah, Iraq
[4] Deceased

* varoujan.sissakian@komar.edu.iq

Abstract

The Kurdistan Region of Iraq (KRI) is mainly a mountainous area with a lot of mountain series and ranges, which are dissected by different types of valleys and streams. The majority of those valleys have developed alluvial fans when flowing out of the mountains. The alluvial fans are of different sizes, shapes, and ages; some of them are dormant (inactive), and others are recent and still active. Some of those alluvial fans have diverted, shifted, and even blocked streams into which they flow. This happens when the sedimentation rate of the alluvial fan is higher than the incision rate of the stream. A good example is the alluvial fans, which are running down the Surdash and Pera Magroon anticlines towards the Qash Qooly, Merga Pan, and Charmaga streams, respectively. To perform the current research, we have used geological and topographical maps of different scales, satellite images, and field observations. Accordingly, we constructed a model of the original stream that was flowing towards NW and merging with the Lower Zab River, which means both Qash Qooly and Merga Pan streams were originally one stream; however, currently, the Merga Pan stream is isolated from Qash Qooly stream by the Surdash alluvial fan and it merges with the Charmaga stream.

Keywords: Alluvial fan, Qash Qooly stream, Merga Pan stream, Charmaga stream, Surdash anticline, Pera Magroon anticline.

GK6- 5

Sedimentology and Depositional Environment of Injana Formation's Sandstone Member, Kurdistan Region, Iraq

Rzger A. Abdula[1], Mohammad S. Nourmohamadi[2], Bzhar A. Delizy[2,*] and Idrees N. Ahmed[3]

[1] Petroleum and Mining Engineering Department, Faculty of Engineering, Tishk International University, Erbil, KRG, Iraq
[2] Petroleum Geosciences Department, Faculty of Science, Soran University, Soran, KRG, Iraq
[3] Earth Sciences and Petroleum Department, Science College, Salahadin University, Erbil, KRG, Iraq

*bzhar.kheder@soran.edu.iq

Abstract

Fourteen thin sections from the sandstone bed of Injana Formation in Chamchamal area were studied by scanning electron microscopy (SEM) and polarized microscope. The petrographic component, fauna content, and bulk density were determined. Sandstone is Calclithite-sedarinite (litharenite) according to Dott's (1964) and Folk's (1980) classifications. The major petrographic constituents are: quartz, K-feldspar, calcite, chert, plagioclase, and fossil (algae). The bulk density of sandstone is 2.67 gm/cm3 and its porosity is 10% which is low, but sufficient to consider the sandstone member as a productive aquifer. The Injana Formation in Chamchamal area was interpreted as littoral and later in a fluviolacustrine environment deposit.

Keywords: Miocene; Injana; Sandstone Sedimentology; Kurdistan Region; Iraq.

GK6- 8

3D Porosity Modeling of Albian-Cenomanian Tight Carbonate Reservoir in West Qurna 1 Oilfield

Maysaa A. Abdulhameed[1], Rafea A. Abdullah[2*], Fahad M Al-Najm[3] and Maher M. Mahdi[3]

[1] Basra Education Directory, Basra, Iraq

[2] Basra Oil Company, Basra, Iraq

[3] Department of Geology, College of Science, University of Basrah, Basra, Iraq

[*] raf32005@yahoo.com

Abstract

Due to the enormous hydrocarbon potential of tight reservoirs in southern Iraq, the development and exploration of these resources have received a lot of attention. For field development to be effective, these reservoirs must be accurately characterized, especially with regard to porosity. This paper provided a comprehensive study on modeling porosity with Petrel software, with the goals of enhancing reservoir characterization and optimizing production strategies. This study uses a multidisciplinary approach that combines well log data, core analysis, and 3D seismic data. Fifty-four wells have been analyzed and studied, well distributed over the study area, in order to understand the reservoir heterogeneity. Porosity modeling is built utilizing different techniques available in Petrel software, including deterministic and stochastic methods. Depending on the properties of the tight Mauddud formation, in this study, the Mauddud formation was divided into two main members, the upper Mauddud and the lower Mauddud. The upper Mauddud member was subdivided into two main units, Upper Mauddud_A and Upper Mauddud_B, and the lower Mauddud member was subdivided into three main units: Lowerv Mauddud_A, Lowerv Mauddud_B, Lowerv Mauddud_C. The most promising reservoir unit is Upper Mauddud_B. The results demonstrate the complexity of the reservoir's porosity distribution. The results of the core analysis show that the Mauddud formation exhibits moderate porosity, with notable variations throughout the field. Porosity readings are extrapolated between wells using well log data, while 3D seismic interpretation is utilized to understand the reservoir's structural. This study also shows that, in general, the characteristics of the Mauddud Formation improve towards the north. This work highlights the value of sophisticated porosity modeling techniques for comprehending and describing tight reservoirs, such as the Mauddud formation in the West Quran 1 oilfield. This technique can be applied to the other tight reservoirs in the region to optimize the hydrocarbon recovery factor and improve reservoir management.

Keywords: Mauddud Formation, Tight reservoir, Porosity model.

GK6- 10

Late Jurassic sequence stratigraphy and hydrocarbon potential in S. Iraq, N. Kuwait, and SW Iran

Hussein S. Aoudah

Ministry of Oil, Oil Exploration Company

hussein.shwayel@gmail.com

Abstract

To reach a comprehensive understanding of the wide differences in the stratigraphy succession of the late Jurassic period northern of the Arabian plate (southern Iraq, north Kuwait, and southwest Iran), the work contexts included the adoption of Sequence Stratigraphy in the domain of development and growth of the sedimentary basin, which takes into consideration the factors that control the architecture filling geometry of the sedimentary basin and the stratigraphic relationships of these sediments, these factors include tectonic and relative sea-level changes that resulting (Limestone – evaporates) in the sedimentation systems late Jurassic period. The study area represents part of the northern Arabian plate, which was subjected to severe structural deformations before the beginning of the late Jurassic sedimentation, which led to the formation of a vast depression (half graben) that formed a starved basin The Graben was created as a result of rift-related tectonism called (the extensional tectonic system) in the latest middle Jurassic period, which led to the accumulation of high organic matter, formed the source rock (Naokelekan Formation) in the center of the Graben during the highstand conditions in the late Jurassic. During the highstand system tract, the horst surrounding the graben represents vigorous carbonate platforms, consisting of coral structures deposition that is followed by, Oolitic grainstone (non-skeletal) sediments and is then covered by Sabkha evaporates sediment (cap rock), this succession of sediments called Najmah Formation western Iraq. This phase was followed by the occupation of evaporites sediments in the center of the graben during lowstand conditions (Gotnia Formation) in southern Iraq - North Kuwait and southwest Iran. Lowstand sea level conditions (represented by the Sequence Boundary type (1)) overlie the Najmah Formation. It has been penetrated by (Sa-1, Dn-1, Sal-1, Gh-1, and Si-1)) wells in southwestern Iraq, the sequence boundary considered the time equivalent of the Gotnia Formation. This research indicates there is a petroleum system distinguished in the west of Iraq composed (reservoir, source rocks, and cap rock), while the eastern part of the study area (southeast Iraq, southwest Iran, and north Kuwait) consists of source rock overlying by center basinal evaporites (Gotnia Formation). There are two types of evaporites sediments, Sabkha evaporites were deposited overlain the Najmah Formation during the latest highstand conditions, second basinal evaporites were deposited in the center basin overlying the Naokelekan Formation and below Sulaiy Formation during the lowstand system tract.

Keywords: sequence boundary, hydrocarbon potential, Iraq, Kawait.

GK6- 12

Using optimum index factorto determine of band combination landsat image data, a case study of site in ne iraq

Talal H. Kadhim

Iraq Geological Survey, Baghdad, Iraq

talalkazem@yahoo.com

Abstract

The optimum index factor (OIF) is computed for each combination the three bands. The Band combination that has the bigger value in factor (OIF) disposes has the more information. The number of band combinations reduced to four combinations based on (OIF) calculation; therefore, the best of combination bands were (7,5,3) , (5,4,3) and (7,4,3) RGB respectively. We found that combination consists of near and middle infrared bands principally (B4, B5 and B7), B5 and B7 these bands are useful for geological studies. As aforementioned we use band combination (4, 3, 2 RGB) too. Pixels of these combinations are taken fill range (0-255) by equalization stretch. Principal competent analysis (PCA) had more advantage in lithological discriminated. This analysis reduced abundance in data image, the combination bands involved are consist of (PC1, 23RGB) which is variance (98.86%) of whole information in all bands but the high variance value in (7, 5,3RGB) is (73%), (PC5, 2,3RGB) also used to discriminated ultramafic and mafic rocks clearly.

Keywords: False color composite (FC) and Principal Component (PCA) and spectral enhancements.

GK6- 13

Lithostratigraphy and Microfacies Analysis of the Govanda Formation (Early-Middle Miocene) in Sherwan Mazin area, Kurdistan region, NE of Iraq

Arkan O. Sharazwri * and Bzhar. A. Delizy

Department of Petroleum Geosciences, Faculty of Science

*arkan.hussien@soran.edu.iq

Abstract

The Govanda Formation was deposited during the Miocene age in the intermountain areas between Zagros Suture and Imbricate zones. Lithostratigraphy and microfacies analysis of the Govanda Formation is studied in the Sherwan Mazin area within Mergasor District, Erbil Governorate to identify the depositional environment of the formation. The Govanda Formation in the studied section is 116 m thick and mainly consist of reddish-brown, hard, thick-bedded,

chert-bearing conglomerate, pinkish shale, yellowish-grey, thick-bedded, detrital, fossiliferous limestone. Petrographically, the main skeletal grains in the Govanda Formation includes benthic foraminifera, planktonic foraminifera, red algae, bivalves, gastropods, coral, and echinoderms, while the peloids and intraclasts are most common non-skeletal grains in the carbonate rocks of the formation. According to the field observation and petrographic analysis four lithostratigraphic units were identified in the Govanda Formation including: basal conglomerate unit (A), shale unit (B), detrital limestone unit (C), thick and massive-bedded limestone unit (D). The formation is unconformably underlaid by the Maastrichtian Tanjeero Formation and conformably overlaid by the Merga Red Beds Formation. The presence of thick conglomerate bed at the base of the formation indicate large unconformity lasted nearly 40 million years. Depending on the detailed microfacies analysis, five main types of microfacies and fifteen submicrofacies are recognized in the carbonate of the Govanda Formation. Based on the microfacies types the depositional environment is defined as open lagoon, reef, fore-reef and back-reef environments of normal to saline, nutrient rich water.

Keywords: microfaceis, Govanda Formation, Kurdistan region.

GK6- 14

Progress in the Maastrichtian Planktic Foraminiferal Paleoecology, and Implications for Paleogeography reconstructions, Kurdistan region, Northeastern Iraq

Imad M. Ghafor[1*], Ibrahim M. J. Mohialdeen[1], Asaad I. Mustafa[1] and Howri Mansurbeg[2,3]

[1] Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Sulaymaniyah, Kurdistan, Iraq.
[2] Department of Geology, Palacký University, 17. listopadu 12, Olomouc 77146, Czechia.
[3] General Directorate of Scientific Research Center, Salahaddin University-Erbil, Erbil 44002, Kurdistan

[*] imad.gafor@univsul.edu.iq

Abstract

The present work interprets the paleoecology and paleogeography of uppermost 20m of the Tanjero Formation based on planktic foraminifera from Dartw section, Sulaymaniyah city, Kurdistan Region, within the High Folded Zone of northeastern Iraq. In total 34 samples were collected to document the planktic foraminiferal distribution for paleoecology and paleogeographic reconstructions. Overall, 45 species from 21 genera of planktic foraminifera were recognized. The results of this study indicate that the well-known planktic foraminifera in the lower part of the section, diagnosed with a double-keeled test, such as *Abathomphalus*, *Marginotruncana*, *Globotruncana, Gansserina* and *Rugotruncana*, which occur at the deep-water depth (more than 100 m depth), the middle part of the section is characterized by the abundance of a genus *Globotruncanella* of a single-keeled test, which is the indicator of the intermediate water fauna (50–100m depth), and the upper part of the studied section is marked by the

abundance of the genera of a non-keeled test, *Hedbergella*, *Heterohelix*, *Pseudogumbelina*, *Pseudotextularia*, *Rugoglobigerina*, *Globigerinelloides*, *Guembelitria, Planoheretohelix* and *Rugotruncana,* which are the indicators of the Shallow water's fauna (around 50m depth). The analysis of the planktic foraminiferal genera in this section indicates a close similarity with assemblages in Tethyan provinces. The total planktic foraminiferal assemblage in the studied samples from the uppermost part of the Tanjero Formation indicates palaeoceanographic conditions favorable for opportunistic organisms, by the evidence of the existence of the genus *Pseudoguembelina*, which is a successful surface and subsurface dweller in tropical and subtropical open oceans of warm and oligotrophic surface ocean waters. It is strongly photosymbiotic and its expansion is related to favorable palaeoecological conditions in the Late Cretaceous Ocean. The studied section implies the presence of a well-stratified water column, tropical to subtropical climate, and deposition in outer shelf to upper bathyal environments, due to the presence of well-preserved and highly diversified Maastrichtian foraminiferal assemblages of the Globotruncanid species which include: *Hedbergella, Praeglobotruncana, Marginotruncana, Globotruncana, Contusotruncana, Globotruncanita, Archaeoglobigerina, Rugoglobigerina, Rugotruncana, Globotruncanella, Gansserina*, and *Abathomphalus*).

Keywords: Planktic Foraminifera Maastrichtian; Tanjero Formation; Paleoecology; Paleogeography; Kurdistan Region, Iraq.

GK6- 15

Benthic Foraminiferal assemblages from the Naopurdan limestone unit (Eocene) paleoenvironmental reconstruction, Sulaimaniyah, Kurdistan region, NE- Iraq

Imad M. Ghafor* and Hemn F. Muhammad

Department of Earth Sciences and Petroleum, College of Science, 46002, Kurdistan Region, Iraq

* imad.gafor@univsul.edu.iq

Abstract

Forty-nine outcrop samples were collected from a 48-m-thick section from the Naopurdan Limestone unit, Dawzhan section, Sulaimaniyah, Kurdistan Region, NE Iraq. Yielded well-preserved benthic foraminifera belonging mainly to the genera Alveolina, Nummulites, Lokhartia, Operculina, Assilina, Rotalia, Disclocyclina, Glomalvelina and Orbitolites. Alveolina is the most diversified genus and is represented by fifteen species including Alveolina , Alveolina archiaci, Alveolina solilda, Alveolina subovata, Alveolina palermitana, Alveolina oblonga, Alveolina cf. munieri, Alveolina leupoldi, Alveolina laxa, Alveolina ilierdensis, Alveolina aff. haymanensis, Alveolina globoas, Alveolina globula, Alveolina elliptica, Alveolina decipiens, Alveolina cosigena, Alveolina sp. A comparison of the fossil assemblage with those assemblages previously reported from both Iraq and other Tethyan sub-basins revealed that the deposition occurred during the Eocene and corresponded to Shallow Benthic Foraminiferal Zones (SBZ) 5–18. The abundance and diversity of the larger benthic foraminifera indicated that the Naopurdan Limestone Unit was deposited under transgressive conditions.

Keywords: Eocene; Naopurdan Limestone Unit; Benthic foraminifera; Kurdistan Region, NE-Iraq.

GK6- 16

Biostratigraphy of the Kolosh and Khurmala Formations, Dohuk area, North Iraq

Noor Al Taee[1], Imad Ghafor[2,*] and Ali I. Al Juboury[3]

[1] Geology Department, College of Science, Mosul University, Iraq

[2] Department of Earth Sciences and Petroleum, Sulaimani University, Iraq

[3]Al-Kitab University, Kirkuk, 36015, Iraq

* imad.gafor@univsul.edu.iq

Abstract

The biostratigraphy of the Kolosh and Khurmala formations is investigated in the Bajlor area, Duhok Governorate, North Iraq. Thirty-four species from 11 genera of planktic foraminifera are described in the Kolosh Formation, while 12 species from 8 genera of benthic foraminifera and 15 species from 13 genera of other microfossils such as skeletal fragments of pelecypods, gastropods, bryozoa, ostracods, and echinoids spine are investigated from the Khurmala Formation. Based on the distribution of the planktic foraminifera in the Kolosh Formation two assemblage zones and two subzones have been determined: -1-*Globanomalina pseudomenardii* Zone (a-*Acarinina subsphaerica* subzone, *Acarinina soldadoenesis* subzone), 2- *Morozovella velascoensis* Interval zone, the representative age of the formation is Thanetian. Based on the distribution of the benthic foraminifera in the Khurmala Formation two zones have been investigated**: -** (1-*Rotalia trochidiformis*- *Rotalia*sp Zone, 2- *Nummulites* sp.- *Triloculina trigonula* Zone. the representative age of the formation is Late Paleocene. The recognized biozones of the Kolosh and Khurmala formations were correlated with comparatively well-known biozones from other parts of the Tethys region which showed a good comparison between the biostratigraphic zones established in this study with other studies.

Keywords: Biostratigraphy; Foraminifera, Kolosh Formation; Khurmala Formation; Duhok area; Iraq.

GK6- 18

Geochemical evidence for paleodepositional conditions of Garagu Formation, Gara Anticline, Kurdistan, northern Iraq

Ibrahim M.J. Mohialdeen[1*], Tola A. Mirza[1], Farhad Ahmadnejad[2] and Shahra O. Abdalla[1]

[1]Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Kurdistan, Iraq

[2]Department of Earth Sciences, Faculty of Sciences, University of Kurdistan, Sanandaj, Iran

[*] ibrahim.jaza@univsul.edu.iq

Abstract

The Garagu Formation is mostly composed of a carbonate beds with iron-rich horizons in the middle part. In this study the geochemical evidences for paleodepositional environment of the Garagu Formation in Gara anticline, Kurdistan Region, Iraq have been discussed. A total of 9 samples from Garagu Formation analyzed by XRF for major elements, ICP-MS for trace elements, including rare earth elements. From geochemical data of major and trace elements, including rare earth elements, a series of identification indexes, such as: Sr/Ba, Rb/ K2O, Th/U, U/Th, V/ (V+Ni), δU, V/Sc, Sr/Cu, and C-Value ratios, were calculated which can be used to indicate, paleosalinity, ancient oxidizing environment, and paleoclimate conditions. CaO has the highest weight percentages in all samples, as expected in this limestone-dominated formation. The FeO shows high percentages in several samples from the iron rich mineralization within the middle part of the formation. The elemental geochemical ratios indicate to saline shallow marine environment with lower salinity in the middle part of the formation. The paleoredox proxies revealed that the oxic to suboxic conditions were prevailed during the deposition of the formation.

Keywords: Kurdistan, Gara Mountain, Garagu Formation, REE, Cretaceous.

GK6- 19

Climate data analysis and drought index from Sulaimaniyah Area, Iraqi-Kurdistan region

Masoud H. Hamed [*], Shevan J. Jirjees ,Kaiwan Karemkhan, Rebar Tahseen and Rebwar Dara

Department of Earth science and petroleum, College of Science, University of Salahaddin, Erbil, Iraq

[*] masoud.hamed@su.edu.krd

Abstract

The primary objective of this study was to conduct a comprehensive analysis of climatic data parameters and drought indices within a significant region located in northeastern Iraq. The investigation focused on the Sulaimaniyah region, utilizing meteorological data spanning from 1980 to 2021 to evaluate both climatic trends and drought conditions. In terms of water availability, the study found that the mean annual rainfall amounted to 697.72 millimeters per year, accompanied by a mean monthly relative humidity of 46.24%. Conversely, concerning water loss factors, the total monthly evaporation recorded was 1688.34 millimeters per year, with an average temperature of 19.44 degrees Celsius and an average sunshine duration of 7.54 hours. The Kharrufa method was employed to determine potential evapotranspiration, allowing for the identification of periods characterized by water surplus and deficit. The analysis revealed that the total potential evapotranspiration, water surplus, and deficit amounted to 1815 millimeters, 364.31 millimeters, and 1481.66 millimeters, respectively. The climate of the research region varies from wet climates in winter to dry climates in summer, and in most cases, it can be assumed that the climate of the study area is determined by (Al-Kubaisi, Mather, and Martonne's) were (Dry-sub humid, Humid to moist, and highly humid), respectively.These findings provide valuable insights into the climatic and hydrological dynamics of the Sulaimaniyah region, contributing to a deeper understanding of water resource management and drought mitigation strategies in the area.

Keywords: Climate Parameter, drought indices, water balance, Sulaimaniyah Area, climate classification.

GK6- 20

Biostratigraphy of the South Caspian basin: insights from offshore and Onshore wells and outcrops in Turkmenistan and Iran

Arzu Javadova

MicroPro GmbH Microbiological Laboratory -Magdeburger Str. 26 b, 39245 Gommern, Germany

javadova@micropro.de

Abstract

A biostratigraphic comparison was conducted between the offshore and onshore regions of the Gorgan-Dag-Ekerem uplift zone in Turkmenistan, utilising published data from the Gorgan Plain in Iran. Notably, commercial reservoirs have been identified in the Pliocene deposits of the SCB, which are of both practical and scientific interest. These deposits underlie the thick Pliocene Red series formations and Akchagylian deposits. 559 samples were collected from the study areas, comprising offshore and onshore Turkmenistan. Abundant ostracod and foraminifera fauna were recovered, enabling the delineation of detailed biostratigraphic sequences within distinct stratigraphic units, including the Pliocene Red series, Akchagylian, and Quaternary deposits such as Apsheronian, Bakuvian, Khazarian, Kvalianian, and Novo Caspian deposits. Significant variations in facies were observed within the Pliocene deposits of the SCB, which influenced the composition of microfauna. This was evidenced by pronounced changes in microfaunal features across different regions of the SCB. The study results indicate that while the Pliocene deposits of the South Caspian Iranian and Turkmenistan areas exhibit relatively low microfaunal richness, the Quaternary deposits are characterised by a rich diversity of mainly brackish ostracods along with euryhaline and freshwater species.

Keywords: South Caspian Basin, sedimentology, lithology, biostratigraphy, Ostracoda, foraminifera, Pliocene deposits, Quaternary deposits, Gorgan Plain, Gogran Dag-Ekerem uplift zone.

GK6- 21

The Application of Staged Factor Analysis (SFA) Method in Geochemical Anomaly Separation, Case study of Shahrak-e-Rabat area, Northwest Iran

Golnaz Jozanikohan[1*], Mohsen N. Abarghooei[2], Shahram Shariati[3] and Minoo Ghanbarzad[3]

[1*] School of Mining, College of Engineering, University of Tehran, Iran

[2]Department of Mining and Metallurgical Engineering, Yazd University, Yazd, Iran

[3]Islamic Azad University (Sari branch), Sari, Iran

* gjkohan@ut.ac.ir

Abstract

The staged factor analysis (SFA) is a type of multivariate statistical technique used for the dimension reduction of analyzed elements as well as identification of paragenetic ore elements in the exploration geochemistry. The differences between this method and factor analysis (FA) lies in the number of FA test carried out. It is proved that the robustness of SFA method helps to have much better interpretation of geochemical data and easier identification of potential mineralization. In this research, the staged factor analysis was carried out on the geochemical data of Shahrak-e-Rabat 1/50000 geological sheet, located in northwest of Iran. The Barika's volcanogenic massive sulphide (VMS) gold deposit type is in Sanandaj-Sirjan zone in which gold mineralization seen in the upper part of the andesite unit through small and large lenses. From Shahrak-e-Rabat 1/50000 geological sheet, 203 stream sediment samples were taken and analyzed for 20 elements, aiming to find more possible gold mineralization in the area. After performing some pre statistical processing stages on the data such as censored/outlier substitutions, and normalization, the isometric log-ratio transform was conducted on data and then the covariance matrix was calculated. Finally, data was back transferred to the centered log-ratio space. The SFA method performed 3 times on the data of 20 elements, and five main factors was obtained that explain 65% of the variability of the remained data. Choosing the optimal threshold (0.6) increased the gold score from 0.569 to 0.804. The fifth factor was shown to be more significant due to having the highest gold score in terms of mineralization. The results of each factor were mapped, and the anomalies showed great match with the gold mineralization indices and mines in the area.

Keywords: Multivariate statistics, Exploration Geochemistry, Gold exploration, Stream sediment sampling, Volcanogenic massive sulphide (VMS) gold deposit.

GK6- 22

Mineralogy, geochemistry and oxygen isotope of iron mineralization from Northeastern Iraq-Gallala area with implications on their genesis

Twana A. Mustafa[1, *], Tola A. Mirza[2], Stavros P. Kalaitzidis[3]and Shahra O. Abdalla[2]

[1] College of Agricultural Engineering Sciences, University of Raparin, Ranya, Kurdistan Region-Iraq

[2]Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Sulaimani, Kurdistan Region -Iraq

[3]Department of Geology, University of Patras, Gr-26504 Rio Patras- Greece

[*] twana.ahmed@uor.edu.krd

Abstract

The Gallala oxide mineralization is located in the Choman district, approximately 150 kilometers from the Erbil governorate, North East of Iraq; in the Kurdistan Region of Iraq, close to the Iraq-Iranian border. Stratigraphically, the study area belongs to the Walash Group, which contains an extended distribution of mafic, intermediate volcanic, and volcano-sedimentary rocks, including oxide mineralization. These ore minerals are hosted within basic to intermediate volcanic rocks, including spilitic basalt, and basaltic andesite. The volcanic rocks of the studied area are designated as Gallala Pillow Lavas (GPL), being characterized by spilitized pillow lavas hosting iron oxides, and associated with red sediments. Clinopyroxene, hornblende, and plagioclase are the predominant minerals in the host rocks. Devitrification and variolitic textures are significant microstructures of the host rocks that occurred under hydrothermal conditions. The trace element signatures and REE distributions of the studied samples suggest that mid-ocean ridge basalt (MORB) is associated with island-arc and back-arc environments in the Gallala area and a calc-alkaline affinity along with a transition to the tholeiite domain. The morphology of the Gallala oxide mineralization predominantly comprises disseminated veins and veinlets within volcanic lithologies. Petrographic data indicates the presence of iron mineralization in altered spilitic rocks, which are affected by hydrothermal alteration such as epidotization, chloritization, susurration, and carbonatization of the GPL section. Geochemical indices obtained from the analyses of the Fe oxide ore minerals, such as petrogenetic discriminate trace element diagrams in iron oxides, along with the high value of $\delta^{18}O$ Fe-oxide corresponding with microthermometric results of the quartz vein of the iron oxides, indicate that ore mineralization took place under a variety of temperature hydrothermal grades. These geochemical signatures suggest that the origin of the ore mineralization is magmatic to a hydrothermal stage of iron mineralization.

Keywords: Oxide mineralization, Hydrothermal, Spilitic basalt, Gallala area, Oxygen isotope, Fluid inclusion.

GK6- 24

Investigate the change in water quality of Dokan Lake using isotopic and hydrochemical Techniques, Kurdistan Region- Iraq

Kamal B. Al-Paruany[1]*, Qusai Y. Al-Kubaisi[2], Ali R. Ajeena[2] Ali A. Jassim[1] Amer A. Muhammad[1], Ali H. Falih[1] and Manal S. Qadir[2]

[1] Environmental and Water Directorate, Ministry of Science and Technology Baghdad, Iraq

[2] Department of Geology, College of Science, University of Baghdad, Baghdad, Iraq

* Kamalalparuany@yahoo.com

Abstract

This study employed isotopic and hydrochemical techniques to determine the water quality of the Dokan Dam with the high scarcity of recharge due to the establishment of the many dams upstream of it. Seven (7) sites were used to choose the samples from the Dokan Lake, Lesser Zab River, and groundwater wells close to the dam during March and August 2021.The hydro chemical data from the Dokan Lake indicated that the major ions throughout both periods were Ca^{2+}, and SO_4^{2-}. The results also showed a significant change in the quality of the water from the Dokan Dam, especially total dissolved solids (TDS), calcium (Ca^{2+}), and sulphate (SO_4^{2-}), which had increased by as much as 37% camper with previous years. For isotopic data, The results showed that there are temporal and spatial variations in isotopic contents in both periods due to the amount of recharging and the impact of the climate (temperature and runoff). The samples under investigation have the highest enriched isotopic footprints, and arranged in order to: Lesser Zab River > groundwater > Dokan dam water, where evaporation activities significantly contribute to enrichment processes with a discernible variation in temperature and other meteorological parameters. Ultimately, the findings showed that low water quality was the cause of the reduction in Dokan Lake and Zab River water quality. The research suggested adopting integrated reservoir management to keep Lake Dokan's water levels stable all year long.

Keywords: Dokan dam, Groundwater, Isotopic, Lesser Zab river, Recharge source and Enrichment**.**

GK6- 25

A geological study of the Busaiya Sub-Basin structure covering part of the stable Arabian platform in Southeast Iraq using geophysical and satellite data

Hayder A. Al-Bahadily[1 *], James D. Fairhead[2], Hanbing Ai[3], Younus I. Al-Saady[1] and Yasir F. Shyaa[4]

[1] Iraq Geological Survey, Baghdad, Iraq

[2]School of Earth and Environment, University of LEEDS, UK

[3] School of Geophysics and Geomatics, China University of Geosciences, China

[4] Oil Exploration Company, Baghdad, Iraq

[*] hayder.adnan17@gmail.com

Abstract

The present research study integrates geophysical, satellite remote-sensing, and surface-geology data to derive and enhance the structural and geological understanding of the Busaiya area in southeast Iraq. An arid climate characterizes this area, which covers 19,500 km^2 and is located tectonically on the stable part of the Arabian Platform. The satellite remote-sensing data provides a unique opportunity to further investigate the surface geology and structure of this previously mapped area without the need to access the area on the ground. The surface geology displays a remarkable eastward dipping succession of Middle Eocene formations to Quaternary sediments. The geophysical data further provides a means of extending this surface geology and structure knowledge to depth. Previous studies of the aeromagnetic data indicate the basement depth extends from 4.5 Km up to ~12 Km and is situated at the edge of a basement block. In this paper, we have utilized (ASTER) Global Digital Elevation Model (GDEM) and Sentinel-2 imagery data as well as gravity, magnetic, and seismic reflection data to study the surface and sub-surface geological structure of the area in more detail, since it could potentially have a future importance in mineral and oil exploration. The interpretation results of the gravity and magnetic data show that the Busaiya is a sub-basin structure developed at the southeastern edge of a basement block structure and has been subsided/reactivated during geologic time. The boundaries and structures within the sub-basin are delineated using edge-detection filters and depths using the tilt-depth method. Moreover, an east-northeast trending 2D depth inversion model using gravity data, across the northern part of the sub-basin, displays the variation in density contrasts both laterally and vertically. Lineaments derived from the gravity data at different depths show a dominated NNE trend at a depth of ~2,000 m. A north-northeast (NNE) trending positive gravity high is located centrally within the sub-basin and divides the sub-basin into eastern and western parts. The estimated depth to the top of this high, from 1D power spectrum analysis, is 2,230 m. The NNE trending lineaments coincide with the interpreted faults seen on poor to moderate-quality seismic sections due to the acoustic nature of the sediments. At the surface, the lineaments deduced from the GDEM imaging show high lineament density while the Sentinel-2 data show distinctive rock deformation at the edges of the sub-basin. The high density of the fault lineaments

could allow the evolution of near-surface good-quality groundwater aquifers. Surface lineaments deduced from the GDEM have a dominant north-south direction similar in direction to the NNE trend of the gravity lineaments. Regions within the Busaiya sub-basin are recommended for mineral and oil explorations according to their structural situation. We conclude that the Busaiya sub-basin area, due to its structural and tectonic positions, has undergone a considerable amount of stress induced deformation leading to subsurface faulting and surface deformation. Further, the area has been affected by the anticlockwise movement of the Arabian Plates, which has contributed to block rotation.

Keywords: Remote sensing, DEM, Geophysics. Arabian Platform.

GK6- 26

Geochemical Characterization and Mechanism of Tar Mats in The Zubair Formation, West Qurna Oil Field, Southern Iraq

Haneen M. Abd aali[1, *], Amna M. Handhal[2] and Basim H. Soltan[2]

[1] Iraqi drilling company

[2] University of Basrah, Geology Department, Basrah, Iraq

[*] haneenmj96@gmail.com

Abstract

West Qurna's Zubair Formation is the field's second-largest reservoir. It is the most important reservoir in the Mesopotamian Basin, in central and southern Iraq, and, near its oil-water contact area, contains variable tar mat intervals. A major focus of the study was the geochemical characterization and mechanism of tar mat formation in the Zubair Formation's upper sandstone (main pay). The tar rock was analysed using gas chromatography and RockEval 6 to determine its depositional environment, the type of kerogen, and its thermal maturity. Furthermore, clay minerals were identified using scanning electron microscopy (SEM). In accordance with the vitrinite reflectance values ranging from 0.52 to 0.53 and the production index ranging from 0.35 to 0.049, the thermal maturity level was immature (low maturity). As a result of the geochemical analysis, marine algae and type II kerogen were also identified as the source of the oil. Further, organic material is deposited under reduced conditions, but oil does not biodegrade. The Zubair reservoir's high temperature (over 80 °C) hinders biodegradation. Based on XRD (X-ray diffraction) and SEM (Scanning electron microscope) results, kaolinite is the most abundant clay mineral. Additionally, the results indicated that gas deasphalting and reduced reservoir pressure are the primary causes of tar mats in the Zubair Formation, which are formed as a result of adsorption on clay minerals. There is an increase in the thickness of the tar mat in the middle part of the West Qurna oilfield. In this way, tar mats create barriers between oil

columns and formation water, preventing secondary oil production. Furthermore, the presence of tar mats can also reduce the permeability of the reservoir, making it difficult to produce oil.

Keywords: Tar Mat, Geochemical Characterization, Thermal Maturity, Biodegradation.

GK6- 27

Petrogenesis of Walash volcanics from Mawat area, Iraqi Kurdistan region

Tola A. Mirza and Jabbar M. A. Qaradaghi*

University of Sulaimani, College of Science, department of Earth sciences and petroleum

*jabbar.faraj@univsul.edu.iq

Abstract

The Walash Volcanics (WV) is well exposed in Mawat town, 37 km north of Sulaimani city, Kurdistan region, within the Iraqi Zagros Suture Zone (IZSZ). A representative traverse along the Mawat-Shasho road, which includes volcanic arc complexes within Walash Volcano-sedimentary group (WVsg), is investigated in detail. Walash volcanics have been studied and classified into three volcanic rock groups. These volcanic rock groups within WVsg comprise basaltic rocks associated with peperites, basalts, and basaltic andesites. Petrographically, basaltic rocks comprise essential minerals such as plagioclase and clinopyroxene as major minerals and olivine, alkali-feldspar, and hematite as minor minerals. As well as the mineralogy of the basaltic andesite rocks in the Walash volcanics consists primarily of major minerals such as plagioclase, clinopyroxene (augite), and K-feldspar (sanidine), along with minor minerals including hematite, titanite, and other Fe-Ti oxide minerals. Secondary minerals such as prehnite, calcite, hematite, mordenite, and palagonite (altered volcanic glass) are present either in vesicles or along the veins within basaltic and basaltic andesite rock samples. Walash volcanics, in terms of their major elements, are characterized as high Alumina-low magnesium basalts, with Al2O3 concentrations around 16-17 wt.% and MgO between 3-4 wt.%. While other major element concentrations are in the range of fresh basalts. There is a noticeable increase in Large Ion Lithophile Elements (LILE) such as Rb, K, Ba, U, Pb, and Sr in all three volcanic groups (Peperite, basalt, and basaltic andesite) within the Walash volcanics, which are considered incompatible elements. Conversely, High Field Strength Elements (HFSE) like Nb, Ta, Ti, P, and Pr generally decrease in abundance in the Walash volcanics across all three groups, except for the enriched Th element in the basaltic andesite group. Based on geochemical data, igneous sections (from peperites) are basaltic rocks with tholeiitic series that are strongly enriched in Light Rare Earth Elements (LREE) with low concentration ratios of (La/Yb) and (Sr/Y), indicating geochemical affinity to normal island arc basalt with a primitive arc signature. Furthermore, their formation is thought to be caused by partial melting of subducted slabs and associated derived fluids above the subducted slab. Multi-element spider diagrams indicate a distinct correlation between the first and second groups

(peperite and basaltic rocks) and the Island Arc Basalt (IAB) pattern with Arc-Basalts, while the third group (basaltic andesite rocks) tends to align closer with the Continental Arc Andesites (CAA) pattern. Petrogenetic indications show that Walash volcanic rocks formed from a normal arc-like magma might result from 20-25% partial melting of basaltic lithosphere associated with slab components (slab-derived fluids and slab sediments).

Keywords: Walash volcanics; Subduction zone; Slab components; Volcanic arcs; Island arc basalts.

GK6- 28

Geochemical characteristics of the sediments along the Shatt Al-Arab and Shatt Al-Basrah rivers bank

Amna N. Al-Amery[1, *], Harith A. Alsaad[2] and Haider M. Jaffar[3]

[1] Oil Ministry, Iraqi Drilling Company

[2] Department of Geology, College of Science, University of Basrah

[3] Oil Ministry, Basrah Oil Company

[*] amna.geo10@gmail.com

Abstract

The studies have been conducted to determine the geochemical variation of the sediments. Twelve samples were taken from recent sediments at a depth of 20 (cm) on the banks of the Shatt Al-Arab and Shatt Al-Basrah Rivers. An X-Ray Fluorescence (XRF) was used for geochemical analysis of the samples. The findings indicated that the primary oxides in the studied area are (SiO, CaO, Al_2O_3, MgO, Fe_2O_3, Na_2O, K_2O, TiO_2, and SO_3). The most abundant oxides are silica and calcium oxide, with smaller percentages of other oxides following. The trace elements are represented by (Ba, Co, Cr, Cu, Nb, Ni, Pb, Rb, Sr, Th, V, Zn, and Zr). The Enrichment factor, Contamination factor, and Geoaccumulation index were computed to assess and analyse the degree of trace element pollution in the sediments of the study area, and the Upper Continental Crust (UCC) background was used for the samples. According to the Enrichment factor, the study area suffers from significant enrichment of nickel in all sites, and moderates to significant enrichment of chromium. According to the contamination factor, the study area suffers from very high contamination with nickel in all sites, high contamination with chromium, and moderate contamination with cobalt, copper, strontium, vanadium, and zinc, in some sites, whereas the Geoaccumulation index indicates that the study area suffers from moderation to heavy contamination with nickel in all sites as well as moderation to moderation heavy contamination with chromium.

Keywords: Geochemistry, Shatt Al-Arab, Shatt Al-Basrah, Major Oxides, Trace Elements.

GK6- 29

Sequence of fold evolution within the Low Folded Zone of the Western Zagros Fold-Thrust Belt of Iraq

Saffa F.A. Fauad[1], Arsalan A. Othman[2,3*], Ahmed K. Obaid[4,5] and Salim H. S. Al-Hakari[6]

[1] Expert and Private Consultant Geologist

[2] Iraq Geological Survey, Sulaymaniyah Office, Sulaymaniyah 46001, Iraq

[3] Petroleum Engineering Department, College of Engineering, Komar University of Science and Technology, Sulaimaniyah, 460013, Iraq

[4] Department of Geology, University of Baghdad, Al-Jadiryah Street, Baghdad, Iraq

[5] Department of Earth Sciences, University of Durham, Durham, UK, DH1 3LE

[6] Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani

[*] arsala.aljaf@gmail.com

Abstract

The Low Folded Zone is the foothill area of the Zagros Fold-Thrust Belt of Iraq. It is dominated by Miocene -Pliocene sediments topography and consists of many folds trains with different dimensions in length, width, and height.The evolution of folds trains within the zone is thought to be in a sequence as inferred by the progressive decrease in the intensity of the deformation from the northeast towards the southwest. In addition to the field investigations and measurements, several indices such as incision rate, topographic positional index, drainage density, etc. have been applied to evaluate the magnitude of deformation in this research. Our detailed investigation of the magnitude of deformation (in terms of dip amount variations), the structural relief, and the relative age of folds (in terms of erosional incision and drainage density) indicates that the evolution of folds trains within the zone deviates significantly into out of-sequence deformation. The deviation might be attributed to changes in the nature of the deformed stratigraphy, the mechanism of folding, and possibly the rate of deformation. Seismic investigations are necessary to shed light on the nature of the deformation of folds train and give a sub-surface overview of the Zagros Foreland Folds evolution.

Keywords: LFZ; Deformation; Zagros; Incision; Fold evolution; Foreland.

GK6- 30

Groundwater assessment and selecting appropriate recharge method in the Erbil Sub-basin, Northern Iraq

Jumaa M. Al – Shwani [1, *], Sabbar Saleh [1] and Diary M. A. Al-Manmi[2]

[1] Applied Geological Department, College of Science, University of Tikrit, Tikrit-Iraq

[2] Department of Petroleum and Energy Engineering, Technical College of Engineering, Sulaimani Polytechnic University

[*] jumaa.k.m@st.tu.edu.iq

Abstract

This study aimed to evaluate groundwater in the Erbil sub-basin and find appropriate methods to recharge groundwater to reduce water scarcity in Erbil and the possibility of benefiting from its water by using it in an optimal way for various uses. This research includes determining hydrogeological setting of aquifer in research area, including groundwater measurement direction & hydraulic characteristics of aquifer. The research showed existence of a shallow aquifer (unconfined) in Quaternary deposits and the presence of an aquifer confined in Bai-Hasan Formation. The flow net showed that groundwater measurement is from northeast to southwest towards Grater Zab River, & hydraulic gradient (I) average is 0.0183. The information from (44) wells shows that values of hydraulic conductivity (K), transmissivity (T), storage coefficient (S), & specific capacity (SC) ranged from (0.061-1.250 m/day), (29.38-183.3 m2/day), (0.001-0.24), and (1.203-15.552 m2/d) respectively, where (K) and (T) were computed using the AQTESOLV program software that depends on methods of Cooper-Jacob & Theis recovery for analysis of this information. Saturated thickness value for each well collected from the bank data of the Erbil Groundwater Directorate range between 120 and 300 m. Renewable storage in the study area is 128.53 × 106 m^3/year, while constant storage is 6709.27 × 106 m^3. The renewable storage in the unconfined aquifer is 1.92 percent of the constant storage.

Keywords: Groundwater; Recharge; water scarcity; Erbil sub-basin; Northern Iraq.

GK6- 31

Revealing for the first time of calpionellids in the Yamama Formation at Rumaila oilfield, Southern Iraq

Rana T. Al-khaya[1*], Maher M. Mahdi[1], Sany E. Hannina[1]and Muslim M. Al-Ali[2]

[1]Department of Geology, College of Science, University of Basrah, Basrah, Iraq

[2] Basrah Oil Company, Ministry of Oil, Basrah, Iraq

[*] alkhyaatr@gmail.com

Abstract

The Yamamma Formation stands out as a critical geological formation due to its substantial reserves of hydrocarbons, making it an essential resource within the oil industry. This research paper unveils a groundbreaking discovery of the abundant protozoa Calpionellids in southern Iraq within the Yamamma Formation. Situated on a carbonate ramp dating back from the late Tithonian to early Hauterivian period, this formation is strategically located at the northern extension of the Rumaila oilfield, one of the most significant oilfields in southern Mesopotamia. Through a comprehensive microfossils survey of ten core samples from the Yamamma Formation, the presence of a diverse array of microplankton Calpionellids was identified for the first time. The species identified include *Calpionella alpina, Calpionellopsis simplex, Calpionellopsis oblonga, Tintinnopsella longa, Tintinnopsella Carpathica,* and *Calpionellites darderi*, indicating a time span from the late Jurassic to the early Cretaceous boundary (late Tithonian to early Hauterivian).

Keywords: Calpionellids, Yammama Formation, Jurassic – Cretaceous boundary, Iraq.

GK6- 32

Seismic Expression of Karst-Related Features and 3D Seismic Evidence of the Effects of Carbonate Karst Collapse and Fault System on hydrocarbon migration path in Merjan-West Kifl Oil Fields, Center of Iraq

Ali M. Al-Rahim[1] and Mohammed S. Fadhel[2]

[1] University of Baghdad, College of Science, Department of Geology, Baghdad – Iraq

[2] Oil Exploration Company, Iraq

*mohammedal_hamdani@yahoo.co.uk

Abstract

A seismic study of 2D/3D data Volume of Merjan-West Kifl oil fields, in central Iraq was conducted to delineate karst features and fault systems in the area and their role in hydrocarbon migration. 3D Seismic data depict karst features and faults that act as a pathway to migrate hydrocarbons from U. Jurassic source rocks (Sargelue and Sulaiy formations) to the L. Cretaceous reservoir rocks (Hartha, Sadi, Nahr Umr, and Zubair formations) in the area. Most of the Cretaceous carbonate formations such as Yamama, Shuaiba, and Mishrif in the area have undergone chemical erosion after the deposition and diagenesis generating karst features. Their surfaces appear as irregular depressions at erosion or collapse of deeper karst hole locations. The seismic reflection image below the karst feature is poor because they have significantly slower velocities than the surrounding sediments. Consequently, high contrast in acoustic impedance occurs, and the seismic reflection signature is distinctive as a Gull-winged depression in cross-section. This was permitted to delineate and map the karst in the area. The size of these karsts is usually a few meters to a few hundred. Delineation of the karst features was attempted utilizing seismic attributes mapping using a variance cube. Seismic attributes were applied to confirm the physical properties and behavior of karsts. They were illustrated with low frequency and high reflection magnitude.

Keywords: Merjan - West Kifl oil fields, Karst and caves, Seismic attribute, Gull-winged depression, Reflection strength, Variance attribute, Migrate hydrocarbons.

GK6- 33

Petrophysical interpretation of unconventional carbonate Sargelu reservoir in Ajeel oil field

Khaldoun.S. Alfarisi [1, *], Mohammed.S. AL Jawad [2] and Abeer Tariq [3]

[1] RFDD, MoO

[2] Department of Petroleum, College of Engineering, Baghdad University, Baghdad, Iraq

[3] Department of Petroleum, College of Engineering, Heriot-Watt University, Scotland, United Kingdom

[*] khaldoun.shaker@yahoo.com

Abstract

This paper aimed to estimate the petrophysical properties (porosity, permeability, and fluid saturation) of the Ajeel-12 well (AJ-12) Sargelu Unconventional carbonite reservoir. Petrophysical properties of the Sargelu Formation at the Ajeel oil field are determined from the interpretation of open hole log data of one well that penetrated the source rock reservoir. In addition, Porosity values and water saturation Sw were calculated along with the depth of the composition using Interactive Petrophysics (IP) V4.5 software for interpretation and advanced interpretation. The results showed that the formation has a large thickness of 130m, and its lithology is shale-rich dolomitic. Also, this reservoir proved to be economical for future developments to increase the production rate of the field by dealing with challenging reservoirs. Moreover, the reservoir is a tight carbonite reservoir; the better porous zone holds the highest amount of hydrocarbons in the middle of the reservoir. Also, the average TOC of advanced interpretations is 6.5. This study proved that the Sargelu reservoir is a source rich continuous accumulation, that adds new accumulations for the unconventional Iraqi reservoir of Jurassic sequences, which increases the reserve locally and the unconventional amount globally.

Keywords: Petrophysical properties, Tight Reservoir, Ajeel field, Sargelu Formation, Iraqi Jurassic Sequences, Carbonate Reservoir, Iraqi Source Rock.

GK6- 34

Building a 3D geological model of the Kurrachine reservoir in Alan oil field

Khaldoun.S. Alfarisi [1], Ghanim Alzubaidi [2] and Mohammed.S. AL Jawad [2, *]

[1] RFDD, MoO

[2] Department of Petroleum, College of Engineering, Baghdad University. Baghdad, Iraq

[*] khaldoun.shaker@yahoo.com

Abstract

Building a 3D geological model from the Kurrachine formation in the Alan Oil field and subsurface data is a typical task in geological studies involving natural resource evaluation and hazard assessment. Kurrachine Reservoir belongs to Upper Triassic; it represents an important reservoir product after Hartha, Jeribe, Qamchuqa, and Shiranish, reservoirs in the Alan field. Two wells Alan has been selected, which penetrated the Triassic sequences lying in Mosul governorate. In this study, a 3D geological model for the Kurrachine reservoir in Alan oil-gas field has been built using petrel 2019 software consisting of structural and petrophysical (porosity and water saturation) models represented by a 3D static geological model in three directions. Petrophysical models have been constructed for the Kurrachine reservoir using sequential Gaussian simulation. In addition, depending on petrophysical properties, the Kurrachine reservoir was divided into five units separated by cap rocks, according to data analyses and the results from modeling, the Kurrachine has a huge thickness from all other reservoirs and a very good reservoir unit regarding its unique petrophysical properties (Tight porosity, tight permeability, and low water saturation) with a high presence of oil in economic quantities. Moreover, cross sections of the porosity model, NTG, and water saturation model were built to illustrate the vertical and horizontal distribution of petrophysical properties of Kurrachine in the Al-1 and Al-2 oil fields. The Structural maps and the surface of the Kurrachine reservoir were illustrated, and, the amount of IIOP was calculated to be 2863.126 MMMSTB, which is an economic estimation for a tight reservoir.

Keywords: Alan oil field, Unconventional Iraqi Reservoir, Kurrachine Tight Reservoir, Iraqi Triassic Reservoir.

GK6- 35

Fracture design of an unconventional Sargelu reservoir in Taq-Taq oil-gas field

Khaldoun S. Alfarisi [1, *], Adnan Ajam [2] and Mohammed S. AL Jawad [3]

[1] RFDD, MoO

[2] Department of Petroleum, College of Engineering, Kirkuk University, Kirkuk, Iraq

[3] Department of Petroleum, College of Engineering, Baghdad University, Baghdad, Iraq

[*]khaldoun.shaker@yahoo.com

Abstract

In this study, a hydraulic fracturing technique is applied to produce the hydrocarbons trapped in the pores of the Sargelu reservoir after designing the fracture, which is considered an Unconventional reservoir of lower permeability. Also, Sargelu is considered to be a source rock. It requires more effort, time, and investment costs than those with higher or high enough permeability. However, by applying this technique, Hydraulic Fracturing vertically and horizontally, through an impermeable source of rock and fracturing, could suck most of the non-recoverable oil of Sargelu out to the surface in the Taq-Taq oil field; this method was first used in the USA, which is now known as “Unconventional Methods.” It is essential to understand that fracturing a rigid rock requires too much pressure, and success is measured as a few meters of penetrations around the wellbore. An essential outcome of about 1.5 million barrels from the Sargelu formation produced after using hydraulic fracturing increase, which is economical and also increases the unconventional potential; many countries now aim to find out if they have economically unconventional reserves. Also, the results showed a successful application of horizontal drilling in the Sargelu reservoir. However, more wells had to be drilled to provide a high production rate and improve the recoverable resources of Sargelu. This adds a new resource in the Kurdistan Region of Iraq to guestimate the unconventional resources, which seem to be the largest unconventional oil exporters in the future, also have essential expectations and current activities on defining their unconventional types and potentials to join the profitability of unconventional with the neighbor countries like Saudi Arabia and Kuwait.

Keywords: Sargelu Reservoir, Taq-Taq oil field, Dynamic Model, Unconventional Tight Iraqi Reservoir, Iraqi Jurassic Reservoir.

GK6- 36

Variation of the seismic b- constant value along the Bitils – Zagros belt in Iraq and surrounding regions

Emad A. Al- Heety[1*] and Huda F. Rafea[2]

[1] Department of Applied Geology, College of Science, University of Anbar, Iraq

[2] Midland Oil Company, Ministry of Oil, Iraq

[*] emadsalah@uoanbar.edu.iq

Abstract

The seismic b - constant in the earthquake frequency – magnitude relationship is a vital factor employed in seismicity, seismotectonics and seismic hazard studies. The spatial and temporal variations of b-constant attracted interest from authors whose focus on spatial variation was more compared to temporal variation. The study aims to investigate the temporal and spatial variations of b- constant and its relationship to focal depth and faulting style along the Bitlis – Zagros Belt (BZB) in Iraq and surrounding regions. The earthquake catalogue in this study was extracted from the earthquake catalogue compiled by Onur et al. (2017) and updated by the Seismological Laboratory of the University of Basrah (SLUB). The seismic catalogue used in the current study covers the period from 1 January 1900 to 31 December 2019. The source of fault plane solutions is the Global Centroid Moment Tensor Catalogue GCMT (http://www.Globalcmt.org/CMT.search.html). To study the temporal and spatial variations of the b- constant, the earthquake catalogue was divided into several time windows (decade, year, month) and the study area into many spatially Zones. Variation of the b-constant value with focal depth was investigated in each selected zone and the dependence on faulting style was studied for the entire of the study area. Because calculating the completeness magnitude (Mc) of the earthquake catalogue is the primary step in estimating the b-constant value, the Mc was calculated for each time window, spatial zone and depth bin. The regression analysis method was used to calculate the b- constant value. The obtained results showed that the b-value decreases in the last decade compared with the previous decades. The b-value is relatively stable and does not exhibit substantial changes over the course of the decade, year, and month. The obtained results showed that the b-value is rather steady and does not change much over the study region. The current study's findings showed that the b-value decreases statistically significantly between 0 and 35 km of depth. The obtained results showed that the strike-slip, normal and reverse faulting earthquakes have low, intermediate and high b-value, respectively.

Keywords: Bitlis-Zagros; b-value; Focal depth; Faulting style; Iraq.

GK6- 37

GPR characterization of buried soil subsidences: using synthetic model and field data

Hussein A. Al-Saady

Iraq Geological Survey, Baghdad, Iraq

hussienalsaady662@yahoo.com

Abstract

This study aimed to deep the understanding of the ability of ground penetrating radar in the engineering studies, such as determine the behavior of soil subsidences. The study simulation GPR response for soil subsidence by building a model of soil subsidence under foundation, where values has been imposed for resistivity, dielectric constant and magnetic permeability to calculate model. The model calculates using antenna frequency 250 and 500 show the shape of reflected related with subsidence. Compare this model with real field data in area exposed soil subsidence. The interpretations of the processed field data reveal to the reflection of signals related with soil subsidence.

Keywords: Simulation GPR, synthetic models, soil subsidences.

GK6- 38

Stable isotope composition and petrography of Dolomite from Jeribe Formation, eastern Iraq, origin and Formation temperature

Mustafa A. Ali[1], [1*,] Saad Z. Al-Mashaikie [2] and Youns I. Al-Saady[3]

[1]Department of Geology, GEOSURV IRAQ, Baghdad, Iraq

[2]Department of Geology, College of Science, University of Baghdad, Baghdad, Iraq

[3]Department of Geology, GEOSURV IRAQ, Baghdad, Iraq

[*]mustafaasaad82@gmail.com

Abstract

Petrographic and stable isotope investigations were conducted on dolomite in the Middle Miocene sequences) of Jeribe formation from the Kirkuk - Dezful embayments in Iraq. This paper discusses the genetic model of dolomite and its texture origin based on C and O isotope analysis results to conclude the formation temperatures and reflected primary isotopic signatures based on a positive correlation between δ 18 O and δ 13 C. The Jeribe Carbonates were petrographically examined and five types of dolomite textures were identified and grouped into two main categories: (i) Unimodal planer-a and s type (anhedral and subhedral) - very fine to fine crystalline dusty dolomite forming the groundmass and having a well-preserved original fabric. Stable isotope analysis shows a positive shift in $\delta^{18}O$ (dolomite $\delta^{18}O$ ranges from 0.12 to 2.89‰ VPDB) and variable values in $\delta^{13}C$ (dolomite $\delta^{13}C$ ranges from -0.87 to 2.74‰ VPDB), depending on the

effect of meteoric waters. The first category of dolomite texture refers to the early stage of dolomitization by syn-sedimentary precipitation. Dolomites of the first category, which are commonly distributed throughout the study samples, suggest a primitive seawater origin. (ii) Polymodal planer-a and e type (subhedral, anhedral, and euhedral) - fine to medium to coarse crystalline. The second category has less preserved fabric and occurs as crystals with clear outer rims and cloudy centres, which are recrystallized from the very fine to fine dolomites. This type of dolomite shows a negative shift in δ^{18} O value (dolomite δ 18 O is -0.97 and -1.15‰ VPDB at the base and top respectively) and δ^{13} C (dolomite δ^{13} C is -1.07 and -1.14‰ VPDB at the base and top respectively). The second category of dolomite is characterized by crystal textures with less preserved fabric. These crystals have clear outer rims and cloudy centres, and are formed by the recrystallization of very fine to fine dolomites. Additionally, diagenetic processes were facies-selective. The meteoric diagenetic zone coincides with the Z index representing a limited influence of meteoric dilution in a shoal, binding reef, and tidal flat facies.

Keywords: Dolomite genesis, Dolomitization, syn-depositional dolomites, Temperature.

GK6- 40

Engineering and Structure Analyses of Rock Slope Stability for Selected Sites at Sartaq Area - Sulaymaniyah Governorate - Northern Iraq

Manal S. Al-Kubaisi, Thair T. Al-Samarrai* and Aya A. Hameed

Department of Geology, College of Science, University of Baghdad, Baghdad, Iraq

*thair.alsamarrai@gmail.com

Abstract

Field studies of the slopes of Bammo Anticline, in Northeast of Iraq, within Sartaq Raod, was carried out in six selects stations, where rock slopes and the discontinuities were surveyed in these stations and its relationships with failures were determined. The field work was revealed the abundance of rock slope failures, the dominant types are rock fall and toppling. Slope stability assessment was carried out by stereographic projection was made using software (GEOrient 9.5.0), the slopes were classified according to Al-Saadi, and the rocks were described in engineering terms according to Anon, and Hawkins on field data. The study also revealed that the factors affecting slope stability in the study area were slope angle, height, dip of strata, and discontinuities. The risk of each site was also assessed depending on the Landslide Possibility Index (LPI) suggested by Bejerman, which showed that the all sites lie within the (High hazard) category. Some remedial measures are suggested for the unstable slopes**,** and the most important removal of the detached block.

Keywords: Slope Stability, Landslide Possibility Index, Stereographic Projection, Discontinuities.

GK6- 41

Strategic drilling decisions based on seismic fault inclination analysis for enhancing hydrocarbon recovery in the Bijeel and Harir oil fields Kurdistan region

Mahdi K. Aswad*, Shokhan Azad and Helin Mohammed

Salahaddin University Erbil, College of Science, Department of Earth Science

*mahdi.aswad@su.edu.krd

Abstract

The seismic method is a well-established technique for delineating subsurface structures and gathering information. This study focuses on the Bijeel and Harir Oil Fields to ascertain subsurface data using seismic techniques. 3D and 2D seismic profiles were employed in the Bijeel and Harir blocks respectively. The 3D seismic profiles reveal the subsurface structure of the Bijeel block, exposing various faults and folds. Reflected lines in the profiles extend to Triassic depths, enabling an investigation into the area's geological structure. This information provides valuable insights into the geologica l characteristics and structural composition of the Bijeel block, aiding in the detailed drilling process and hydrocarbon recovery of this oil field subsurface formations. The 2D seismic profile of the Harir field, particularly in the Mirawa (well-1) and Harir (well-1) area, depicts significant fluctuations in reflected lines, indicating the presence of a major anticline within the subsurface. Based on this informat io n, numerous faults and folds were identified in this oil field and subsurface formations. These identificat ions assist oil drilling companies in selecting suitable locations and directions for development drilling operations to enhance hydrocarbon recovery in the fields.

Keywords: Subsurface Geology; Seismic Fault Inclination; Hydrocarbon Recovery; Bijeel and Harir Oil Fields; Kurdistan Region.

GK6- 42

Machine Learning for Electrofacies Identification in Nahr-Umar Reservoir in the Majnoon Oil Field

Ala'a A. Al-Malki[1], Safaa M. Abdulkareem[2*], Mohammed A. Abbas[2] and Watheq J. Al-Mudhafar[2]

[1]Basrah University for Oil and Gas

[2]Basrah Oil Company

[*] safaamajid@taboo.com

Abstract

In the characterization and modeling of reservoirs, a crucial stage is the facies prediction. The process of developing reservoirs will be improved, and economic strategies will be optimized, through the definition of a representative reservoir model. Alternative strategies must be used in order to improve the reservoir characterization process because the lack of data is a major problem. In this study, clustering analysis was used as a statistical method to categorize reservoir facies using well logs and core data from the Majnoon oil field, a reservoir in southern Iraq. Data from a heterogeneous clastic reservoir were used in this study. Data from well logs such as GR, SP, Density, Neutron Porosity, Total Porosity, Resistivity, Induction, Shale Volume, Water Saturation, as well as porosity and permeability values from core analysis were also included. To do a clustering study, these data were combined and examined statistically. Finding the similarities and differences between particular groups of points in order to categorize them into different classes is done using the clustering analysis method. The EM Algorithm, a very potent open source tool for statistical investigations with a range of functions and packages to categorize reservoir facies depending on the provided data, was used to put this concept into practice. The findings of this research showed that the reservoir facies were predicted through the EM clustering analysis when well logs records are given. EM Algorithm approach has predicted the optimal facies classification to be three optimal reservoir facies. The EM-based predicted electrofacies are then incorporated along with the well logging data into the permeability modeling to capture the reservoir heterogeneity and improve the overall characterization of the reservoir.

Keywords: Clustering analysis; electrofacies identification; EM algorithm; clastic reservoirs; well logging attributes.

GK6- 50

Porosity Evolution of the Qamchuqa Formation, Early Cretaceous succession in Northeastern part, Iraq

Afnan Al -Zubadi* , Zubaida Al-Anbaky and Abdalratha Mohammed

University of Diyala, College of Science, Department of Petroleum and Mineral Geology

* afnanmuntherafnan19971997@gmail.com

Abstract

The Qamchuqa Formation was studied in Kosrat Anticline in Dokan area in Sulaimanyia governorate, Kurdistan region, Northeastern Iraq. The 14 slides of 14 rock samples were made and studied under different microscopes. Petrographic properties and types of pores determined in this study, related to Qamchuqa Formation. The formation consists of three units. Lower Unit (162 m) consists of dark grey, massive limestone. Middle Unit (139 m) consists of alternation of grey very coarse crystalline dolomitic limestone and yellowish green marl. Upper Unit (384 m) consists of grey massive limestone and dolomitic limestone. The high values of porosity in the Qamchuqa Formation can be resulted from vuggy porosity and the stylolite systems too. The high values of porosity in last stage of pores evolution can be attributed to intercrystal porosity, vuggy porosity and secondary fractures systems. Three types of pores were found in Qamchuqa Formation, these are intercrystal dolomite pores, vuggy pores, and microfracturs pores. The Qamchuqa Formation in the present study at Kosrt anticline can be considered as a petroleum reservoir because of the ratio of bitumen materials to the size of pores. As well as, Qamchuqa Formation in the present study is characterized by leakage of petroleum materials to the surface.

Keywords: Qamchuqa Formation, Evolution of pores, Vuggy pores, Microfractures, intercrystal pores, Leakages of Petroleum, Qalat village.

GK6- 52

Ancient shoreline delineation using subsurface data and remote sensing techniques: a case study in the Arabian Gulf

Arsalan A. Othman[1, 2 *], Salahalddin S. Ali[3], Ahmed K. Obaid[4,5], Younus I. Al-Saady[6], Maher M. Mahdi[6], Mustafa Ali[7] and Hasan K. Jasim[4]

[1] Iraq Geological Survey, Sulaymaniyah Office, Sulaymaniyah 46001, Iraq
[2] Petroleum Engineering Department, College of Engineering, Komar University of Science and Technology, Sulaimaniyah, 460013, Iraq
[3] Civil Engineering Department, College of Engineering, Komar University of Science and Technology, Sulaimaniyah 46013, Iraq
[4] Department of Geology, University of Baghdad, Al-Jadiryah Street, Baghdad, Iraq
[5] Department of Earth Sciences, University of Durham, Durham, UK, DH1 3LE
[6] Department of Geology, College of Science, University of Basrah, Basrah, Iraq
[7] Iraq Geological Survey, Al-Andalus Square, Baghdad 10068, Iraq

[*] arsala.aljaf@gmail.com

Abstract

About 6000 years ago before the present, part of southern Iraq was covered by water when the present shoreline of the Arabian (Persian) Gulf (AG) was much higher. The sea level rose ~4 m above its present level, inundating the lower parts of Mesopotamia. Along the AG shoreline, several ancient settlements had been built, such as Bad-Tibira, Eridu, Girsu, Lagash, Larsa, Tall Al-Laham, Tall Um-Al-Aqareb, UR, and Uruk. These ancient towns were located close to the ancient shoreline of the AG. Nowadays, there is no clear indication of the spatial existence of the ancient shoreline, and no ground survey or fieldwork to verify its exact location has been conducted. The proposed study aims at filling this gap by (1) determining the ancient shoreline of the AG and, (2) detecting the ancient anthropogenic sites using several remote sensing data, which are validated by fieldwork and subsurface data. We selected two study areas in the southern part of Iraq. The first one is the prospected ancient AG and the second is Al-Naseria town and surrounding area. Almost all of the major anthropogenic sites have been detected, such as Uruk, Larsa, Tall Al-Laham, Tal Um-Al-Aqareb, Girsu, and UR. These sites are located in places higher than the surrounding area using a topographic positional index (TPI) with a 5 m threshold. These towns were located close to the ancient shoreline of the AG. Our study shows that the ancient shoreline of the AG is located about 190 and 230 km northwest of the present-day shoreline. The interplay between climate, tectonics, and erosional activities of the study area have been studied. The humid climate, mild tectonic activities, and active erosion have a direct relationship with the sea-level rise and verse versa. The major contribution of this research is identifying the spatial distribution of ancient communities and their relationship to the sea. Moreover, the results show neotectonic activity (uplift) for the area located between Al-Amarah and Al-Majer area.

Keywords: Hammar; Zagros; Sumer; Majnoon Anticline.

GK6- 53

Geochemistry of trace and rare earth elements in different topsoil of Lesser Zab River basin, Kurdistan region, Northeast Iraq

Younus I. Al-Saady[1], Arsalan A. Othman[2,3*], Salahalddin S. Ali[4], Yousif O. Mohammad[5], Ahmed K. Obaid[6,7], Veraldo Liesenberg[8] and Syed E. Hasan[9]

[1] Iraq Geological Survey, Al-Andalus Square, Baghdad 10068, Iraq

[2] Iraq Geological Survey, Sulaymaniyah Office, Sulaymaniyah 46013, Iraq

[3] Petroleum Engineering Department, College of Engineering, Komar University of Science and Technology, Sulaimaniyah, 46013, Iraq

[4] Civil Engineering Department, College of Engineering, Komar University of Science and Technology, Sulaimaniyah 46013, Iraq

[5] Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Sulaimaniyah 46013, Iraq

[6] Department of Geology, University of Baghdad, Al-Jadiryah Street, Baghdad, Iraq

[7] Department of Earth Sciences, Durham University, Durham, UK

[8] Department of Forest Engineering, Santa Catarina State University, Lages, Brazil

[9] Department of Earth & Environmental Sciences, School of Science and Engineering, University of Missouri, Kansas City, MO 64110-2499, U.S.A

* arsala.aljaf@gmail.com

Abstract

The distribution of trace (TEs) and rare earth elements (REEs) in topsoil is important to understand how natural and man-made factors affect their geochemical behavior. The signature and content of REEs in topsoil are affected by the main controlling factors represented by pedogenesis parent material. Although the composition of parent materials was vital for differentiating REEs, pedogenesis significantly altered the accumulation and distribution of REEs in topsoil. The topsoil of the Lesser Zab River Basin (LZRB) in northeast Iraq is a mostly primitive environment with diverse parent materials varying from igneous to sedimentary rocks. This study aimed to identify the distribution characteristics of TEs and REEs in topsoil, involving fractionation, provenance, weathering characteristics, and enrichment, in addition to investigating the relationship between these elements and topsoil texture. We collected twenty-five samples from LZRB to examine the distribution behavior and fractionation of TEs and REEs in topsoil. The results show that the mean total concentrations of the light REEs (∑LREE) and heavy REEs (∑HREE) in the topsoil samples were 50.24 µg/g and 5.68 µg/g, respectively. The topsoil of the LZRB is enriched in LREE (La to Eu) and depleted in HREE (Gd to Lu). The total REE concentrations in topsoil samples of LZRB ranged from 25.57 µg/g to 183.10 µg/g with an average of 55.92 µg/g. These REEs concentrations were found to be lower than the REEs concentrations of the North American Shale

Composite (NASC; 173.21 µg/g) and the Post-Archean Average Australian Shale (PAAS; 184.73 µg/g). Moreover, we found that the topsoil mineralogy and texture, particularly clay size, positively correlates with the REEs and TEs content indicating that the topsoil texture plays a significant role in the mobility of REE. According to our results, most topsoil samples are enriched in HREEs compared to the LREEs, with (La/Yb)N ratios ranging between 28.76 and 66.34. Variations in topsoil TE and REEs content are attributed to the varying factors that affect the formation of topsoil such as parent rocks, transportation, climate, topography, and weathering intensity. Q1: based on this research result, what is the implication? Is this affecting the environment negatively or positively, Are there any economic, environmental, and scientific benefits from this result? Q: What are the precautions (if there is a negative effect) and what are the recommendations?

Keywords: Topsoil; Trace earth elements; Rare earth elements; geochemistry; Lesser Zab River Basin; Northeast Iraq.

GK6- 54

Microfacies and Depositional Environment of (Lower Cretaceous) Balambo Formation in selected area, Imbrication Zone, Northeastern Iraqi Kurdistan Region

Aheen O. Abdullah[1] * and Sardar M. Balaky [2]

[1]Department of Earth Science and Petroleum, College of Science, Salahaddin University, Erbil, Kurdistan region, Iraq

[2] Department of Petroleum Geosciences, Faculty of Science, Soran University, Soran, Kurdistan region, Iraq

*aheen.omer@gmail.com

Abstract

The Microfacies and depositional environment of Balambo Formation (Lower Cretaceous) in well-exposed section from the northeastern limb of Spi Balies – Mama Ruta anticline near Chombarok village, Soran area in the imbrication zone was studied. Lithologically, the formation consists of 450 meters of rhythmic alternation between thin, medium and thick bedded of yellowish-gray and grayish black marly limestone, dolomitic limestone and limestone, with thin, medium to thick bedded, olive green marl and gray to black shale. Thin bedded, lenses and nodules of cherts are present in different levels of the studied formation. Depending on the field observation and petrographic investigations, two lithofacies types are recognized; Cherty limestone and Marly limestone-marl lithofacies. The petrographic study of carbonate rocks deepened on 79 thin sections, showed that the majority of limestones are carbonate mud (micrite), with abundant deep marine macro and micro faunas such as ammonites, belemnites and bivalves, planktonic foraminifera, radiolarians, calcispheres, ostracods, pelecypods, larva-ammonoids, small brachiopods, planktonic gastropods, sponge spicules, echinoid spines and

plates, oligostegina and bioclasts. Non skeletal grains include peloids only.Based on detailed microfacies analysis, three main microfacies are recognized; Mudstone, wackestones and packstone microfacies, and those microfacies subdivided into ten sub-microfacies. According to their environmental interpretation, these facies were subdivided into three basic types of facies associations: Basinal deep-water, Deep shelf and toe of slope. From the sum of all petrographic, facies and textural investigations, it is concluded that the Balambo Formation in the imbrication zone of NE- Iraq was deposited in a deep marine environment from deeper part of basin to deep shelf and toe of slope environments.

Keywords: Balambo, microfacies, depositional environment, Imbrication zone, Iraqi Kurdistan.

GK6- 55

Studying geological structures and basement depth using gravity, magnetic, and STRM data for the Al-Jazira Area, NW-Iraq

Ahmed S. Mousa* and Hayder A. Al-Bahadily

Iraq Geological Survey, Department of Geology, Geophysics Division, Baghdad, Iraq

*ahmed.alazzaw72@gmail.com

Abstract

The Al-Jazira area lies in the northwest of Iraq and is part of the northern Arabian Platform. The area is described by relatively thin Phanerozoic sediments covering the Precambrian fractured basement complex. The area is also characterized by an outstanding gravity high. Tectonically, some studies included the area within the stable part of the Arabian Platform, while others regarded it within the unstable part. This study analyzes the gravity and aeromagnetic data to study the subsurface lineaments and other geological structures. The gravity data in the form of a decompensative anomaly map (DAM) was used to delineate the geological structure in the upper crust. The map shows three complex prominent gravity minima including a NW-trending gravity low in the east and a circular low in the south. To understand the structural makeup of the study area, in more detail, the gravity and magnetic field derivatives represented by the total horizontal derivative, theta map, analytic signal, and local wavenumber and unbiased lineament detection technique known as CET (Center for Exploration Targeting) were applied to the data. Accordingly, four sets of lineaments/faults were determined that are thought to be responsible for basins development in the Al-Jazira area. In addition, a 3D gravity inversion has been made to calculate depth-to-basement, depth-to-Moho, and lateral density variations. The inversion results show three main lows and significant highs. Additionally, an interesting high region on the Moho surface has been detected. The estimated depths-to-basement are between 6.5 and 11 km and the estimated depth-to-Moho is about 32 km. The Moho depth is shallower than expected and this interprets the source of gravity high. It is suggest Neotectonic activity in the area as it is still

affected by the Alpine Orogeny. The results of this study suggest doing a gravity survey in more detail for new potential hydrocarbon prospects in certain regions within the area.

Keywords: Gravity; Magnetic; Basement Depth; Al-Jazira Area; Iraq.

GK6- 58

Log Permeability and ILT comparison, Upper Shale Member at Rumaila Oilfield as Case Study

Muslim M. Al-Ali[1,*], Uday Alshawi[1], Safaa M. Al-Adhab[1] and Maher M. Mahdi[2]

[1]Basrah Oil Company, Ministry of Oil, Basrah, Iraq

[2] University of Basrah, College of Science, Geology Dept., Basrah, Iraq

[*] muslim.alali@roobasra.com

Abstract

In the dynamic landscape of hydrocarbon recovery, the optimization of extraction techniques remains pivotal. Two such methods, permeability enhancement and water injection, stand out prominently in the domain of petroleum engineering. Both approaches aim to maximize production rates and ultimate recovery from oil and gas reservoirs. This essay undertakes a comparative analysis of permeability enhancement and water injection, exploring their principles, applications, advantages, and limitations. Water injection, also known as water flooding, is a secondary recovery method that involves injecting water into the reservoir to displace hydrocarbons towards production wells. This process maintains reservoir pressure, improves sweep efficiency, and enhances oil recovery rates by pushing trapped oil towards the wellbores. Permeability estimation encompasses diverse methods and data sources for calculation and prediction. One prevalent approach involves deriving permeability from core data and subsequently extrapolating it through various geological modeling techniques. However, despite its commonality, this method harbors a wide range of uncertainties owing to the constraints of limited core data and the challenges posed by formation coverage discrepancies when comparing core plugs with reservoir properties. The primary objective of this study is to obtain more dynamic data to validate the concepts and methods used in permeability calculations. Injection logging serves as a reflection of formation permeability, incorporating various parameters that either enhance or diminish reservoir quality. The proposed approach involves comparing calculated permeability values with injection data, specifically Injection Logging Tool (ILT) measurements, which entail cumulative total injection rates correlated with cumulative permeability. This initial stage of the study focuses on validation. Subsequent steps will involve refining the model using both injection and production data to enhance permeability calculations, aiming for an improved representation of formation quality. The study dealt with one of the most important geological formations containing hydrocarbons, which is the Upper shale member in the Rumaila oilfield, and the results showed great importance in this field.

Keywords: Injection Logging Tool, permeability, injection, petroleum engineering, Upper Shale member, Rumaila oilfield, Iraq.

GK6- 60

Provenance of Dune Field Sediments by Studding Heavy Minerals in Al- Najaf area, Central Iraq

Mohammed L. Hussein[1,*], Mohanad R. A. Al-Owaidi[2] and Hamid A. A. Alsultan[2]

[1] Department of Medical Physics, College of Sciences, Al-Mustaqbal University, 51001, Babylon, Iraq

[2] Department of Applied Geology, College of Science, University of Babylon, Iraq

[*] mlh960960@gmail.com

Abstract

Heavy minerals (HM) properties of the + 63 micron fraction of the dunes terrigenous sediments in AlNajaf area, central Iraq were carried out. Twelve samples collected from two areas, one of them at AlManathera, whereas the other is about 3 km from Madhlum village. Ten samples were chosen to examine by transmitted and polarized microscope, supported by SEM- EDS technique to determine the types of the heavy minerals. The heavy minerals were separated from the light minerals using a heavy liquid (bromoform) and examined using a reflected polarized microscope. Those are; zircon, tourmaline, rutile, opaque, garnet, amphibole, orthopyroxene, clinopyroxene, biotite, chlorite, muscovite, and epidote. The opaque heavy mineral makes up the majority, while staurolite constituting the minor portion. The minerals are relatively close to a metastable state in terms of stability. According to HM study, the amount of unstable minerals in the Najaf dunes is approximately 12.7%, whereas the amounts of metastable and ultra stable minerals are approximately 15.81% and 16.83%, respectively. The percentage of opaque particles in Najaf dunes is relatively high, around 34.04%. The order of the heavy minerals due to their contribution percent were: opaque > zircon >tormaline > rutile > epidote > garnet > amphible > pyroxene > biotite> muscovite > chlorite > kyanite > celestite. The dunes are mature sediments. The study dunes represents mature positive continental margin. The research results reveal that the felsic igneous rocks (granitoid rock), metamorphic rocks (gneiss and schist), and earlier sedimentary rocks are the sources of the Najaf sand dunes. The primary source of sand for the dune fields of Najaf is the Dibdibba Formation (Pliocene – Pleistocene) in Tar Al-Najaf, where sediments are carried from the Arabian Shield, with contribution from Zagros belt of northern east of Iraq.

Keyword: Al-Najaf, provenance, dunes, minerals, stability, sediments.

GK6- 61

Stratigraphy and microfacies analysis of the lower Miocene sediments: a new record from the Duhok rea, northern of Iraq

Abdulrahman Bamerni[1, *], Ashti Barzani[2] and Arkan Sharazwri[3]

[1] College of Science, University of Duhok. Iraq

[2] Technical College of Zakho, Duhok Polytechnic University. Iraq

[3] College of Science, Soran University. Iraq

[*] abdulrahman.qasim@uod.ac

Abstract

The carbonate successions at Geli Besare, Duhok, north of Iraq studied in aspect of stratigraphy, microfacies and age determination. three rock units identified; Euphrates, Dhiban Anhydrate, and Jeribe formations, which were merged previously as Pila Spi Formation. The Euphrates Formation is the target for this study, in the field, it's bounded unconformably with the Pila Spi Formation from the bottom that overlies the Eocene *Alveolina* bearing limestone of Avanah Formation, and conformable with the Dhiban Anhydrate and Jeribe formations from the top. The Euphrates Formation is subdivided into three main parts from the base, subconglomeratic-brecciated dolostone, chalky dolomitic limestone, and tough dolostone respectively. These successions are strongly dolomitized, recrystallized and show no macrofossils content. The petrographic study reveals the existence of four main microfacies (Mudstone, Wackestone, Packstone, and Crystalline dolomite), and ten submicrofacies as follow; dolomicrite mudstone, dolomitized fenestral mudstone, dolomitized mudstone, intraclastic wackestone, bio peloidal wackestone, algal wackestone, intrclastic wackestone, ooilitic packeston, bio intraclastic packstone, benthonic foraminifera bioclastic packstone, and peloidal packstone submicrofacies. The biostratigraphic investigations for the three units show the existence of the Borelis melo (Fichtel and Moll) var. curdica Reichel from the base of the Jeribe Formation in the studied succession, that is restricted to the late Early to Middle Miocene in age. The field investigation, the petrographic study, and the microfacies analysis all reveal that the Euphrates Formation is deposited in a wide tidal flat with low angle, progressing from a restricted to open lagoonal marine environment.

Keywords: Miocene, Euphrates, Jeribe, Microfacies, Duhok.

GK6- 62

Reservoir characterization of the Late Campanian and Maastrichtian Shiranish Formation, Kurdistan Region, Iraq

Basoz J. Salih, Hussein S. Hussein* and Omer Th. Taher

Department of Petroleum Geosciences, Soran University, Soran, Erbil 44002, Iraq

* hussein.hussein@soran.edu.iq

Abstract

Conventional well logging methods are crucial for detecting petrophysical properties and are instrumental in reservoir characterization, particularly when subsurface rock samples are unavailable. In this study, log data and thin sections were employed to determine the petrophysical properties of the Late Campanian-Maastrichtian Shiranish Formation in the Kirkuk area (X field) and Dokan area, Kurdistan Region, Iraq. Various approaches were integrated, including the Neutron-Density Crossplot for lithology identification, Gamma ray logs for determining shale volume, and sonic, density, and neutron logs for assessing porosity and fracture porosity. The Shiranish Formation exhibits good porosity, with maximum values reaching 27.1% from the sonic log, 30.4% from the density log, and 29.1% from the neutron porosity log. Additionally, the maximum fracture porosity index observed in the studied well is 10%. Lithologies identified from the Neutron-Density crossplot indicate that the Shiranish Formation is predominantly composed of limestone and marly limestone. The determined shale volume within the examined interval reveals a high level of clay constituents. The reservoir quality of the Shiranish Formation in the outcrop section is negligible, as evidenced by the thin section samples used in this study.

Keywords: Porosity, Shale content, Reservoir characterization, Shiranish Formation.

GK6- 63

Systematic taxonomy of exceptionally well-preserved Planktic Foraminifera from the Oligocene, Sangaw area, Kurdistan region, NE- Iraq

Imad M. Ghafor* and Pshtiwan M. Ahmad

Department of Earth Sciences and Petroleum, Sulaimani University, Iraq

* imad.gar@univsul.edu.iq

Abstract

This work is done for the first time -preserved assemblages of planktic foraminifera that were recovered from 2m thick of the Pungalla outcrop section through from the Tajil Formation (Rupelian-Chattian) in the Sangaw area, Kurdistan Region, NE- Iraq. We illustrate and discuss the detailed taxonomy of eighteen species from five genera of planktic foraminifera which are: -

Paragloborotalia opima, Paragloborotalia sp.; *Dentoglobigerina galavisi*, *Dentoglobigerina sellii*, *Dentoglobigerina tripartite*, *Dentoglobigerina baroemoenensis*, *Dentoglobigerina globularis*, *Dentoglobigerina binaiensis Dentoglobigerina* sp., *Dentoglobigerina globosa*, *Dentoglobigerina eotripartita*, *Dentoglobigerina binaiensis*, *Dentoglobigerina venezuelana*, *Dentoglobigerina prasaepis*, *Globigerina ampliapertura*, *Globigerina ciperoensis*, *Globorotalia opima opima*, *Globorotaloides suteri* and *Subbotina gortanii*, These species are in an excellent state of preservation, so the tests permit detailed investigation of wall textures and surface ornamentation, helping us to elucidate details of functional morphology and clarify the species-level and higher taxonomy of the group.

Keywords: Oligocene; Tarjil Formation; Planktic Foraminifera; Systematic Description; Northeastern Iraq

GK6- 66

The importance of 2D electrical resistivity imaging (ERI) at a pre-engineering construction site in Duhok city, Iraq

Kaheen Abdullah [1,*], Alfred Mansour [2] and Rashied Mohammad [1]

[1] Department of Geology, College of Science, University of Duhok, Kurdistan-Iraq

[2]Directorate of Groundwater, Duhok

* kaheen.abdullah@uod.ac

Abstract

Significant subsurface cavities were unexpectedly discovered during initial excavation at a proposed construction site in central Duhok City. These voids raised concerns about structural integrity, safety, and potential project delays. The extent and dimensions of these cavities were unclear, necessitating a thorough investigation. To address these issues, a detailed investigation using 2D electrical resistivity tomography (ERT) with the Wenner-Schlumberger array was conducted to map resistivity variations and identify voids. The results from inversion sections of Towers 2 and 5 revealed significant subsurface cavities, posing geotechnical risks. The area in Tower 2 exhibited cavities at depths of 5 to 12 meters, with resistivity values exceeding 1500 Ohm.m in sections (T2-1), (T2-2), and (T2-3), necessitating immediate remedial actions for structural stability. Tower 5 showed cavities with high anomalies at depths of 3m, 4m, and 5m in section (T5-1), and depths around 2-4 meters and 3-6m in section (T5-2), with a major cavity exceeding 6m in section (T5-3). Tower 3 also showed significant cavities at depths ranging from 5 to 15m in sections (T3-1) and (T3-3), highlighting the need for careful evaluation before construction. Tower 4 featured circular caves at depths of 5 to 12 meters in sections (T4-1) and (T4-2), and a prominent circular cavity from 2m to 12m in section (T4-3), emphasizing the importance of thorough subsurface assessment in construction planning circular voids and elongated caves at depths ranging from 7 to 15m requiring further investigation. The high-

resolution imaging from the ERT surveys was crucial for early construction planning. Integrating geophysical methods like ERT ensures safer construction practices and long-term structural resilience. By identifying geohazards and enabling timely interventions, future structural issues are minimized, optimizing construction strategies for urban development projects.

Keywords: Electrical Resistivity method; Wenner-Schlumberger array; Inversion models; Cavity detection.

GK6- 69

Evaluation of gypsiferous soils and their geotechnical properties in Kalar, Kurdistan Region, Iraq

Ali Uromeihy[1, *], Avesta Mohammad[2], Mohammad Fathollahy[2] and Bestun Jumma[3]

[1] Tarbiat Modares University, Tehran, Iran

[2] Kurdistan University, Sanandaj, Iran

[3] Koya University, Erbil, Iraq

[*]uromeiea@modares.ac.ir

Abstract

Soil exists in the foundation of many engineering projects or is used as one of the main materials construction, therefore, knowledge of their characteristics and engineering behavior is essential. Kalar City, which is regarded as a major city in the Garmiyan region, has a network of various communication roads and related structures that pass through mostly soil lands. Due to the geological setting of the region, that contain evaporate compounds such as Fatha and Injana Formations in the form of gypsum layers, the covering land deposits are expected to be seen as gypsiferous soil. Gypsiferous soils are soils that contain gypsum. Gypsiferous soils have self-cementing properties when compacted but they contain leachable sulphate which are a constraint on their use. The amount of gypsum has a considerable influence on soil properties, especially the chemical properties of the soil solution in which directly influences its engineering behavior. In addition, gypsum, whether in massive or particulate form, dissolves and produces caverns and/or progressive settlements, accelerating seepage flows and accompanying deteriorations of foundation. It is reminded that gypsum damage to pavements is typical in arid environments. This typical pavement damage results from local heaving of the prime coat or the wearing course to form blisters independent of the traffic and is related to the presence of soluble salts in the pavement or the subgrade. Therefore, it is necessary to study the amount of gypsum compounds in different places and the extent of its effect. In order to derive the physical properties and chemical components of the soil, many samples were collected from 10 different places around Kalar City. According to sieve analysis large percentage of the sample are fine particle and can be identified as ML and CL according to the Unified Classification System. where their plasticity index (PI) is in the range of 2 to 9 for the clay and silt particles, respectively. The

percentage of gypsum in the soil sample varies between 2 to 8 regarding their location toward the outcrop of the geological gypsiferous layers. The engineering behavior for the samples with various percentage of gypsum content were examined by conducting the direct shear tests test. The result showed that by increasing the gypsum from 5%, 10% and 20% for a silty soil, the friction angle first decreased from 35 to 17 and increased up to 22 degrees. while the cohesion increased 13 to 27 kPa respectively. The shear strength of the sample decreased sharply as the gypsum content increased.

Keywords: Geotechnical, Iraq- Kurdistan, gypsum.

GK6- 71

Petrography and Geochemistry of Injana Formation in selected sections, North-eastern Iraq: Implications for provenance and tectonic setting

Sattar J. AL-Khafaji * and Nael Al-Najaari

Department of Geology, College of Science, University of Basrah, Iraq

*Khafaji52000@gmail.com

Abstract

Two surface sections of Injana Formation namely; Bazin and Darbandikan in sulymaniya area were studied in terms of petrography and Geochemistry. The assemblage of heavy minerals; pyroxene, amphibole, epidate ,staurolite , garnet , kyanite as well as zircon and tourmaline are found in similar percentage in both sections, except for chlorite and magnesite which were detected in high percentage in Bazian samples indicated the contribution of both metamorphic and basic igneous as a source rocks of Injana Formation . Inductively coupled plasma mass spectrometry (ICP-Mass) technique was used to determine the content of Major, trace and REE in sand and silty clay samples. $SiO_2$and (Al_2O_3 + K_2O+ Na_2O) diagram showed that Injana Formation was deposited under arid to semi-arid paleo-climate conditions. Cr , Ni ,Co, V and Sc indicated the mafic source rocks , Zr,Hf,Th, U and Sr tend to increase in sand samples due to their highly resistance to chemical weathering .Nb/y and Zr/TiO_2 diagram resemble the alkali -Basalt source of Injana deposited Th/Sc , Zr/Sc , Cr/ Ni , Th/ Co , Th/Cr and La/ Co reveals that Injana deposits was mainly derived from basic (Basalt) to intermediate (Andesite) rocks .LREE / HREE, LaN / LuN and Eu/ Eu values indicated an enrichment in LREE with decreasing of grain size and increases of clay content.

The REE normalized patterns indicated that the basic (basalt) and intermediate (Andesite) are source rocks of Injana deposits.

Keywords: Injana formation, REE, Geochemistry, Basalt, Semi-arid conditions.

GK6- 72

Exploration of clay layers as a raw material for cement production from Quaternary sediments using 2D Electrical Resistivity Imaging, Mineralogical, and Geochemical Investigations in both Bazian and Takya areas, Kurdistan Region, NE Iraq

Bakhtiar Q. Aziz[1,*], Hawkar O. Hamaamin[2], Omer A. Rashid[2], Rezhan R. Osman[2] and Rezhan J. Mohammad[2]

[1] Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani

[2] Directorate of Oil and Mineral in Sulaimani

[*]Bakhtiar.aziz@univsul.edu.iq

Abstract

Clay materials are widely used in the production of cement due to the presence of good amounts of silicon oxide (SiO_2), aluminum oxide (Al_2O_3) and ferric oxide (Fe_2O_3) that play an effective role in mixing with limestone to make Portland cement. So, exploring for good quantity and quality of clay has become an important requirement for cement factories in general and in particular in both Bazyan and Takya regions due to the existence of more than five factories that produce millions of tons from Sinjar Formation annually. 2D Electrical Resistivity Imaging (ERI) is conducted using Wenner-Schlumberger array for detection clay layers in the Quaternary Sediments. Mineralogical and Geochemical studies are carried out to determine the quality of detected clay layers. About 13 clay samples collected from different locations and depths depending on the results of 2D ERI by digging 9 trenches to a depth of 12 m as well as some others samples are collected in clay layers appear on several vertical cliffs have highs ranging from 7-10 meters. a Cliff which about 9 heights on clay layers that identified by 2D ERI profiles. Geochemical analyzing was carried out for seven clay samples to determine the proportion of major and minor element. Six samples were analyzed for mineral composition by XRD and determining the grain size. The results of 2D ERI survey showed that there is a large amount of clay bodies in the Quaternary sediments at depths between 2 m - 80 m with electrical resistivity ranging between 7 – 11 Ohm.m and the average thickness of the clay layer is ranging between 5 – 45 m. The chemical composition analysis indicates the existence of a high ratio of silica, alumina, and iron oxide equal to 65.9 %, 11.66 %, and 4.4 % respectively in the Takya study area and equal to (33.58-37.63) %, (9.96-9.56) %, and (4.9-4.33) % respectively in the Bazian study area. Grain size analysis shows that the majority is silt size, ranging from 48 to 58%, especially in the trenches, and then clay size ratio, ranging from 36 to 47%. The sand size in both study areas has the lowest ratio, ranging from 4% to 6%. The result is represented by silty clay and silty clay loam, according to the USDA diagram. Eventually, the mineralogical study indicates that the major portion of clay samples is montmorillonite, the miner portions are palygorskite and kaolinite, and the non-clay minerals include quartz, feldspar, and calcite. The result of the integrated studies is the detection of thick layers of clay with optimal quality that can be used for several years as a raw material for the cement industry.

Keywords: 2D Electrical Resistivity Imaging, Clay raw material, Cement factory, Geochemical and grain size analysis.

GK6- 74

The prospect of seismic monitoring of the Darbandikhan Dam and surrounding region

Hemin Ahmed[*1], Rahand Majeed[1], Saman Esmail[1], Abdulrahman Khani[2], Rami Ibrahim[3] and Hafidh A. A. Ghalib[3]

[1] Directorate of Darbandikhan Dam, Kurdistan, Iraq

[2] General Directorate of Dams and Reservoirs, Kurdistan, Iraq

[3] EMR Solutions & Technology, USA

[*] hemingeology@gmail.com

Abstract

Darbandikhan dam is an embankment dam located in Kurdistan Iraq, a seismically active region. The Zagros Fold and Thrust Fault belt is known for generating significant earthquakes, including the devastating magnitude 7.3 Halabja earthquake that struck the region on 12 November 2017. The purpose of this study is to examine the seismic activity in the region over the period 1917 to 2023, and its recent impact on the Darbandikhan dam structure. A total number of 6138 events are found in national and international catalogs within the geographical region 44.9°-46.9° E and 34.4°-35.6° N with magnitude between 1.0-7.3 and focal depth ≤ 20 km. We also examined the induced seismic events activity in the area by comparing it with the water level of the dam's reservoir. It showed a positive correlation between the occurrence of some of the earthquakes with the loading and unloading of the Darbandikhan reservoir. Considering Kurdistan Iraq Seismological Network (KISN) stations are sparsely distributed, we propose deploying a dense local network of the seismic and strong motion stations in and around the dam. The proposed network would consist of: (1) a network of strong motion stations on and inside the body of the dam to analyze its response to earthquake shaking, (2) a network of short period or broadband seismic stations distributed throughout the vicinity of the dam region to monitor the local seismic activity, and (3) a network of GNSS sensors consisting of stationary GPS systems to measure the rate and direction of tectonic deformation associated with the occurrence of earthquakes in the region. Note, these proposed networks should also be considered for the other dams in Kurdistan Iraq, *e.g.*, Dokan, Duhok as well as Mosul dam, because they are all subject to seismic activity in the north and northeast of the country.

Keywords: Darbandikhan dam, Kurdistan Iraq Seismological Network (KISN), earthquake, GNSS.

GK6- 75

Assessment of Air Contamination in Mosul University Campus using Remote Sensing and GIS Techniques

Alaa N. Hamdon*, Sabah H. Ali , Abdalrahman R. Qubaa and Hikmat S. Al-Daghistani

Remote Sensing Center, University of Mosul, Iraq

* Alaa.hamdon@uomosul.edu.iq

Abstract

Air contamination is very crucial case in densely populated areas like university campuses. Therefore, this study investigates the levels and spatial distribution of air pollutants within Mosul University Campus using remote sensing and Geographic Information Systems (GIS) techniques. A combination of satellite imagery and ground-level monitoring data is utilized to assess key pollutants such as particulate matter (PM2.5 and PM10) and other gases. Remote sensing data (satellite imagery and DEM) are processed to derive spatially distributed information of pollutant concentrations and the effect of topography on it. GIS techniques are employed to analyze the spatial patterns and correlations between pollutant levels and various campus features such as transportation routes and green spaces. Furthermore, ground-level monitoring stations are strategically positioned across the campus to validate and complement the remote sensing-derived data. The findings of this study provide valuable insights into the sources and dispersion patterns of air contaminants within the Mosul university campus for the period of (Winter,2023, Spring and Summer,2024) in a (16) selected sites. The results indicated a highest concentration of PM2.5 and PM10 particles in Spring than in the Summer and Winter seasons with the values of (30.594 µg/m3) and (40.298 µg/m3), respectively. The highest concentration values of PM2.5 and PM10 particles were saw in the main entrances to the university campus due to the increased traffic. Also. PM2.5 value exceeds both the Iraqi limit level and the WHO standard (10 µg/m3), while, PM10 concentration level exceeds the WHO standard limits of (20 µg/m3), but fall within Iraqi standard limits of (50 µg/m3). The results of the current research contribute to effective environmental monitoring methodologies and underscores the importance of employing innovative technologies for assessing air pollution in educational institutions and urban environments.

Keywords: Air contamination, PM2.5, PM10, Mosul university, GIS.

GK6- 77

Implications of climate change in Kurdistan region of Iraq, floods in 2024 as example

Jawhar H. Khalid*and Aso K. Taib

Directorate of Meteorology and Seismology Sulaymaniyah, Kurdistan Iraq

*jawharkh70@gmail.com

Abstract

Climate change refers to long-term shifts in temperature, precipitation patterns, and other atmospheric conditions on Earth. Effects of climate change have appeared in the Kurdistan Region of Iraq, air temperatures have risen by 1.3 degrees Celsius over the past fifty years, according to data recorded by the Meteorological Department in Sulaymaniyah. We noticed changes in the type and quantity of precipitation, especially in recent years, from the lack of annual precipitation or heavy rain in a few hours, as the annual amount of precipitation in the years 2021 and 2022 was much less than its annual rates, but in this year 2024 we noticed heavy rainfall in a few days and hours, as the amount of precipitation during 24 hours was recorded at 159 mm from the meteorology station in Duhok on March 19, 2024, and because of this abundance, floods occurred in the Kurdistan Region of Iraq. In this research, we followed the conditions of weather elements, including atmospheric pressure, air temperatures, and relative humidity, a month before the flood occurred, that is, from February 18, 2024, to March 20, 2024, to see the changes and weather fluctuations that led to the flood. We took data from meteorological stations in Dohuk, Bamerni, Erbil, Soran, Sulaymaniyah, Halabja and Kalar. It was found that the temperature range during the month before the flood was between 19.1 and 24.8 degrees Celsius in the stations, the relative humidity was between 13 and 100, and the atmospheric pressure was clearly fluctuating in the region. These conditions lead to a state of atmospheric instability, which in turn qualifies for the formation of accumulating clouds and cumulonimbus, producing thunderstorms, heavy showers, and floods.

Keywords: Air temperature; Atmospheric pressure; Relative humidity; Rainfall; Diurnal Temperature

GK6- 78

Statistical analysis on the aftershocks of the February 06, 2023, Turkey-Syria earthquake

Nokhsha Aziz*, Basoz Ali and Nian H. Amin

Kurdistan Iraq Seismological Center, Directorate of Meteorology and Seismology, Sulaymaniyah, Iraq

* nokhsha.aziz@gmail.com

Abstract

Aftershocks following a big earthquake can persist for weeks, months, or even years. The duration and frequency of aftershocks may differ based on different factors, such as the unique fault system and geological circumstances. It is essential to recognize that aftershocks are often of a smaller magnitude than the mainshocks, however, they still have the potential to cause damage and present a risk to affected regions. An earthquake with a magnitude of 7.8 occurred in southern and central Turkey, as well as northern and western Syria, on 6 February 2023. This resulted in significant human casualties and economic damages. The epicenter was located 37 kilometers in the west-northwest direction of Gaziantep and caused a significant concentration of ground motion along the East Anatolian Fault. The earthquake had a maximum Mercalli intensity of XII - Extreme - around the epicenter and in Antakya. The aftershock data for a year was gathered from the Disaster and Emergency Management Authority (AFAD), Turkey, which included 21159 events located between 35.2–40.1° E and 35.9–39.3° N. The magnitude varies from 2 to 7.8, with 95.69% of the data found in the upper crust at depths less than 20 km. It was noted that 38% of aftershocks occurred between February 6th and February 28th, while 81% occurred within the first five months. The aftershocks exhibited exponential decay over the course of one year, resulting in a decrease in seismic activity at the source area to approximately 2 events per day. The Omori-Utsu law that describes the temporal decay of aftershocks was extracted using one-month aftershock data. The predicted aftershock rate was larger than the observed in the first few days, and consistent in most days, the anomalies appeared with time could be an indicator of fault activation in the region that caused to a higher number of the aftershock activity. The decay rate of the aftershocks of the Halabja earthquake (Mw 7.3 on 2017) shows a better approximation with Omori-Utsu law if compared to the Turkey – Syria earthquake. This work provides information to understanding the seismotectonic mechanism, related damages, and characterization of Turkey – Syria earthquake sequence.

Keywords: Gaziantep, aftershocks, Omori-Utsu.

GK6- 79

Unified earthquake catalog of Iraq and its neighboring regions

Sangar A. Ahmed[1*], Rami Ibrahim[2], Basoz Ali[3], Fadhil I. Khudhur[4] and Hafidh A. A. Ghalib[2]

[1] Directorate of Meteorology and Seismology, Erbil, Kurdistan, Iraq

[2] EMR Solutions & Technology, USA

[3] Kurdistan Iraq Seismological Center, Sulaimaniyah, Kurdistan Iraq

[4] General Directorate of Meteorology and Seismology, Erbil, Kurdistan, Iraq

* sangar.geology@gmail.com

Abstract

A revised earthquake catalog for Iraq and neighboring countries is compiled using local and international sources for the period 1905-2023. All duplicate events in the reviewed earthquake catalogs are eliminated. Our final list contains 48,211 earthquakes that occurred in southeast Turkey, Syria, Iraq, Jordan, north Saudi Arabia, Kuwait, and western Iran. An area defined by the geographical coordinates 26° - 40°N and 36° - 51°E. The magnitude of the events varies from 2.5-7.8, with 10 earthquakes above magnitude 7.0. A percentage of 89.2% of the events hypocenter are in the upper crust at depths δ 20 km. Most of the earthquakes are associated with the active continental collision zones between the Arabian and Eurasian plates delineated by the Bitlis-Zagros suture zones and the East Anatolian fault system. A continuous belt characterized by high level of recurring seismic activity and devastating earthquakes like the recent *Mw 7.3* Halabja in 2017 near the Iraq-Iran border and the *Mw 7.8* and *Mw 7.5* Kahramanmaras earthquakes in 2023 near Turkey-Syria border. The reason for creating this revised earthquake catalog is to use as a foundation for developing a seismic zoning map for use in seismic hazard assessment, engineering and construction projects in Iraq, in particular.

Keywords: earthquake, East Anatolian fault, Arabian and Eurasian plates.

GK6- 80

Estimating seismic intensity map of the Halabja m_w 7.3 November 12, 2017 earthquake using the proposed strong-motion seismic network in Kurdistan Iraq

Layla Omer[1*], Hemin Hashem[1], Fadhil I. Khudhur[2] and Bakir S. Ali[3]

[1] Directorate of Meteorology and Seismology, Sulaymaniyah, Kurdistan Iraq

[2] Directorate General of Meteorology and Seismology, Erbil, Kurdistan Iraq

[3] EMR Solutions & Technology, USA

[*] sulydatacentereq@yahoo.com

Abstract

The need for an expanded network of strong motion stations arises from broadening monitoring coverage, enhancing the accuracy of earthquake parameter calculations, and enabling effective measures to mitigate seismic risks. Thereby, in turn, ensuring the protection of communities and critical infrastructure. A seismic intensity map was assessed across 30 proposed strong motion station sites in Kurdistan, Iraq using a scenario earthquake resembling the 2017 Halabja earthquake (M_w 7.3). Seismic intensity is linearly proportional to peak ground acceleration (PGA), which was estimated using the ground motion model (GMM) of Boore & Atkinson (2008). PGA values were derived considering the shear-wave velocity of the top 30 meters of soil (Vs30), sourced from the database of the USGS website. Subsequently, ground motions were corrected for local site amplification based on the V_{S30} database. The shortest distances, which described as the Joyner_Boore fault distance (R_{jb}), from each station to the surface projection of the source model presented by Nissen et al (2019). The calculated result shows the maximum intensity (VIII) was estimated at locations such as Kalar, Darbandikhan, and Maidan, intensity (VII) at Halabja city where the most damages were reported. The intensity gradually decreased with distance from the source area, thus the damages also reduced. Our estimated intensity map and field reports showed high similarity, validating our methodology's efficacy. These efforts significantly contribute to the prompt and accurate crucial role in expediting the evaluation of earthquake damage and executing targeted rescue operations. Assess the damage caused by the earthquake, and facilitate accurate emergency response efforts in affected areas.

Keywords: intensity, strong motion network, ground motion model, earthquake mitigation, emergency response.

GK6- 81

Improvements to Permeability Prediction using Data Fusion models and Deep Learning based on OWA Operators

Hamid Hakiminezhad[1*], Behzad Moshiri[2] and Golnaz Jozanikohn[3]

[1]Computer Department, Islamic Azad University, Central Tehran Branch, Tehran, Iran

[2]School of Electrical and Computer, College of Engineering, University of Tehran, Tehran, Iran

[3]School of Mining Engineering, College of Engineering, University of Tehran, Tehran, Iran

[*] Hakimi.hamid@gmail.com

Abstract

The permeability is a reservoir property accounting for the fluid flow through reservoir rock and represents one of the most significant factors in oil and gas production. This parameter is measured via core laboratory tests, which is an expensive and time-consuming method and of course not feasible for all wells in a huge field. Nowadays, permeability is calculated using petrophysical data by means of some statistical and intelligent techniques. The present research was carried out using data of four wells of Kangan and Dalan Formations in South Pars Gas Field, Iran. To reduce the uncertainties of petrophysical data, among the various methods of data fusion, Dempster-Shafer theory, a known approach to deal with data with uncertainty is used in this study. Then, four more effective features were selected from 8 features extracted from each well, using the feature selection method based on Pearson correlation coefficient, uniformity and autocorrelation methods. Deep learning model, i.e., deep neural networks (DNN) was used as a promising approach to improve efficiency. Used deep neural network used in this study in combination of OWA operators, resulted in enhancing the effective and useful parameters in permeability prediction. Finally, these improvements led to an increase in the accuracy of permeability prediction with a coefficient of determination of 0.9799 and a reduction of the square root of the mean squared error to a value of 0.101. Then, the results of pervious methods such as MLP neural network and fuzzy system for permeability prediction were investigated. The results were then compared with the data fusion method and machine learning with OWA operators and proved the robustness of deep learning in combination with the OWA operators.

Keywords: Reservoir permeability, (MLP) neural network, Data fusion, Deep learning, OWA, Fuzzy system.

GK6- 82

Mineralogical and Geochemical Study of Quaternary Deposits at Al-Khora region in Basrah Governorate , Southern Iraq

Khaleel J. Al-Sudani and Ajel S. Y. Al-hadadi*

Department of Geology, College of Science-University of Basrah, Basrah, Iraq

*ajel.yassen@uobasrah.edu.iq

Abstract

Forty samples that were taken at a depth of one to five meters below the surface from selected sites in the southern Mesopotamian plain known as Al-Khora region in Basrah governorate. Grain size analysis showed that sediments composed of different percentage of silt, clay and minor sand. Mineralogical analysis reveal that calcite, quartz, dolomite, feldspar, and gypsum are the dominant non-clay minerals in the studied area. Clay minerals analysis indicates that montmorillionite, illite, palygorskite, kaolinite, and chlorite, are presented in different ratio. Geochemically, the most major oxides in the sediments, represented by SiO_2, Al_2O_3, Fe_2O_3, CaO, MgO, Na_2O, SO_3, K_2O, TiO_2, SrO and P_2O_5 were found in a main phase within the crystal lattice of clay minerals. The presence of trace elements content in the sediments such as zirconium, chromium and vanadium indicates to the contribution of igneous source rocks with a basic and ultrabasic composition. Through the relationship between both the ratio of silica oxide to aluminum, sodium, and potassium oxides ratio showed that the paleclimate of the study area at different depths were represented by semi- arid climate. Tectonic setting was represented by active continental margin and oceanic island arc margin. The decrease in the TiO_2 content is due to the weak hydrolysis processes, which is one of the chemical weathering factors, and thus the decrease in the proportion of minerals resistant to weathering.

Keywords: Mineralogy, Major oxides, Trace elements, Quaternary deposits, Basrah.

GK6- 84

Relationship of LST, NDVI AND NDBI using landsat 5, 8 and sentinel 2A data in Baghdad city

Sarmad.H. Mahal[1*] and Asma'a A.Hamead[2]

[1] Department of Astronomy and Space, College of Science, University of Baghdad

[2] Department of Geology, College of Science, University of Baghdad

[*] sarrmad.h@sc.uobaghdad.edu.iq

Abstract

The analytical method of the study relies on changes in Normalized Difference Built-up Index (NDBI), Normalized Difference Vegetation Index (NDVI), and Land Surface Temperature (LST); GIS technology was used to measure these statistics. Landsat (5,8) and Sentinel 2A imagery were used to detect the change of urbanization growth, vegetation change, and land surface temperature during the study period from 2001 to 2020, whereas used the unsupervised classification technique for determination for NDVI and NDBI variations. This study was aimed to recognize the spatial and temporal features of urban development and its impact on the climate of Baghdad City. The results showed significant changes among the NDVI and NDBI in the studied periods, as most of the NDVI and NDBI changes were caused by human activities. The most prominent changes are the urban expansion on agricultural land, continuously in all years, which led to the decline of vegetation resulting from land degradation. The Building area increased from around 862 km2 in 2001 to 1457 km2 in 2020 concentrated mainly in the center, the northeastern and southeastern part of the city. Moderate plants decrease from around 800 km2 in 2001 to 428 km2 in 2020 and dense plants decreased from 172 km2 in 2001 to 0.0009 km2 in 2020. This has led to negative effects on the climate where temperature rates increased from (12-32) degrees Celsius in 2001 to (19-36) degrees Celsius in the last year of the study, the highest temperatures were recorded in urban growth areas and areas without vegetation. There is a negative relationship between NDVI, LST and a positive relationship between LST and NDBI. The highest negative correlation R between LST and NDVI was in March 2001(R=0.99), while the highest positive correlation R between LST and NDBI was in March 2020 (R=0.996).

Keywords: Normalized Difference Vegetation Index, Normalized Difference Built-up index, Land Surface Temperature (LST), satellite images, Correlation coefficient (R).

GK6- 85

Using Spectroscopy Regression Analysis to Predict hydrocarbon in Soil around the North Rumaila Field, Southern Iraq

Zahraa A. Khaleel [1*], Auday H. Shaban [1] and Ali A. Al Maliki [2]

[1] Department of Remote Sensing & GIS, College of Science, University of Baghdad, Baghdad, Iraq

[2] Ministry of Science and Technology, Environment, water and renewable Energy directorate Baghdad, Iraq

[*] Aligeo1969@gmail.com

Abstract

Hydrocarbon soil pollution is one of the most dangerous pollutants in the world, which occurs for several reasons and increases as a result of factories not adhering to environmental protection controls, the most prominent of which are oil production factories. In this work, two sets of soil petroleum contamination, were used to demonstrate principal component analysis (PCA) and partial least squares regression (PLS) modelling. To determine the variables adopted in this study based on spectroscopic analysis within the spectrum range of 1700 -1800 and 2200-2400 the distinct absorption peaks at 1720, 1750, 2220, 2300, and 2350 nm indicate the crude oil content and chemical analysis of the samples to achieve the relationship and build a PLS and PC model, which helped in obtaining a high percentage of match of up to 90%. The work indicates that this technique may enhance field investigation of oil contamination, providing an accurate in-field technique.

Keywords: Regression model, Hydrocarbon, Petroleum, Soil contamination, spectrometer.

GK6- 86

Kinematic and Geological Strength Index-slope Application for Rock Slope Stability Evaluation along Old Azmar Road in a Part of Azmar Anticline, Sulaimaniyah, NE-Iraq

Ghafor A. Hamasur [*], Salim H. S. Al-Hakary and Fahmy O. Mohammed

Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani

[*] ghafor.hamasur@univsul.edu.iq

Abstract

Roads and highways in the Iraqi Kurdistan mountainous areas have an important role in the remote transport system. Any instability in the slopes may lead the traffic to get worse and bring seriousness to people. Also, the study of rock slope stability aids the successful excavation designing of rock slopes for road construction or expansion purposes and maintaining other engineering projects in a safe state. This study comprises choosing ten (10) excavated rock slope stations along old Azmar road, on the NE-side of Azmar mountain at Sulaimaniyah, NE-Iraq, and

the stability of these excavated rock slopes was evaluated by descriptive and quantitative approaches. Selection of the slope stations has relied on the changes in the discontinuity type, slope steepness and orientation, and failure type. The field data was analyzed to determine its possible type of instability, employing the slope kinematics method by the DIPS v6.008 program, and to verify the stability condition, the Geological Strength Index-slope (GSI_{slope}) system was also used, which is a new geomechanics system. Also, the joints were geometrically classified, based on the three (3) orthogonal geometric axes. Geometrical classification of joints revealed an ac-joint set, and hko>a, hko>b, hol>c & okl>c joint system. The most prevalent type is of conjugate hko joint system, whereas there are no conjugate joint systems of hol>a & okl>b types. Kinematic analysis showed four failure types, i.e., planar sliding, wedge sliding, flexural, and direct toppling failures. Planar sliding may occur in the rock slopes of stations no. 2, 3, 4, 5, 6, 7, 8, 9, and 10, wedge sliding may occur in the rock slopes of stations no. 1, 8, and 9, flexural and direct toppling may occur in the station no. 5 rock slope. The results of the GSI-slope showed that the rock slopes in stations 3 and 5 are in the completely unstable condition of class no. Five (V), and stations no. 1, 2, 4, 6, 7, 8, and 9 are in the unstable condition of class four (IV), while the slope in station no. 10 is in a partially stable condition of class three (III).

Keywords: Azmar anticline, GSI, Imbricated zone, Rock Slope stability, RMR, Western Zagros.

GK6- 87

Determining the best productive horizons in the heavy oil content Hartha Formation from a selected well in the x oilfield in Northern Iraq using wireline log data

Dler H. Baban[1]*, Ayub M. Ahmed Shwani[2], Qays M. Sadeq[2], Shadan M. Ahmed[3] and Sabir S. Barzinji[4]

[1] Department of Geology, Sulaimani University, Sulaimaniyah, Kurdistan Region-Iraq

[2] North Oil Company, Kirkuk, Iraq

[3] Department of Earth Sciences and Petroleum, Sulaimani University, Sulaimaniyah, Kurdistan Region-Iraq

[4] North Oil Company, Kirkuk, Iraq

* dler.mohamad@univsul.edu.iq

Abstract

The 140 m thick upper Cretaceous Hartha Formation in the selected well A from the X Oilfield in northern Iraq was investigated using conventional wireline logging and core test data to detect the best horizons for production and calculate net to gross reservoir, pay, and productive ratios. The formation in the studied field, which is located in the Makhul-Hamrin Subzone and is known as a heavy oil-containing field, consists of limestone, dolomitic limestone, and dolostone, with slightly argillaceous limestone and dolostone at its lower part. The data from the recorded gamma ray log showed that the Hartha Formation is generally clean with less than 10% shale content, except for the lower 10m of the formation, where the shale content increases to about 15%. The formation in the studied well has good porosity, ranging between 10% and more than 30%, with the secondary porosity representing between 0 and 5% of the total porosity in different horizons, especially in the middle part of the formation. The permeability of the formation generally ranges between less than 0.1 mD and about 10 mD, with an exceptional high permeable zone in the dolostone dominated middle part of the formation. The entire Hartha Formation in the studied well contains hydrocarbons in different ratios, which gradually decrease towards the lower part of the formation. The greater portion of the existing hydrocarbons are immoveable. The calculated Flow Zone Indicator (FZI) values indicate the existence of four Hydraulic Flow Units (HFU) in the formation, whereas the calculated Moveable Hydrocarbon Index (MHI) values showed that there are moveable hydrocarbons in most parts of the formation except for a few horizons at the lower part of the formation. Suggesting a 1.0 mD permeability cutoff, the Hartha Formation in the studied well has about 43% net reservoir, 42% net pay, and 36% net productivity, whereas if a 5 mD permeability cutoff is suggested, the formation has 18.5% net reservoir and 17.8% net pay, with about 16.4% net productivity. In case of suggesting 10 mD permeability cutoff, the formation has only 8.5% for each of the net reservoir and net pay with only 7.8% net productivity.

Keywords: Hartha Formation, Reservoir units, MHI, FZI, N/G ratio.

GK6- 88

Oil-oil and oil-source correlation of crudes and source rock extracts from selected wells and outcrops in the Southern part of the Iraqi Kurdistan region

Dler H. Baban* and Shadan M. Ahmed

Department of Earth Sciences and Petroleum, Sulaimani University, Sulaimaniyah, Kurdistan Region-Iraq

* dler.mohamad@univsul.edu.iq

Abstract

The oil-oil and oil-source rock correlation done for the oils, extracts, and seepage samples from different wells and outcrop localities within the southern part of the Iraqi Kurdistan Region (Garmian and surrounded areas) based on identified biomarkers and chemical composition of the oils and extracts. The quality of the organic matter within the Jurassic source rocks appeared to be mostly type III or III/IV, whereas kerogens type III/II and II/III dominate the Cretaceous and Paleogene source rocks, respectively. The correlation output showed different oil groups originated mainly from the known middle and upper Jurassic source rocks, with indication to contribution of source rocks from Paleogene (most probably Aaliji Formation). Almost all of the analyzed oil, bitumen, and extract samples are sourced from a carbonate environment under reducing depositional conditions. Most of the bitumen extracted from the outcrop samples is heavily degraded. Five oil and extract groups have been identified depending on ratios of normal carbons starting from NC11 to NC22. The chemical composition of the oil and extract samples (SARA) indicated existence of different types of unsaturated aromatic and saturated paraffinic-naphthenic crudes.

Keywords: Source rocks, Kurdistan Region, oil-oil, oil-source, crude oil.

GK6- 89

3D static geological modeling for the Tertiary reservoir in the main southern dome of the Ajeel oilfield, Northern Iraq

Sabir S. Barzanji[1], Dler H. Baban[2 *], Muhana M. Ahmed[3] and Kanaan A. Jasim[4]

[1] North Oil Company, Kirkuk, Iraq

[2] Department of Earth Sciences and Petroleum, University of Sulaimani, Sulaimaniyah, Iraqi Kurdistan Region

[3] Department of Geology, University of Tikrit, Tikrit, Iraq

[4] Department of Geology, University of Tikrit, Tikrit, Iraq; Oil Exploration Company, Baghdad

[*] dler.mohamad@univsul.edu.iq

Abstract

One common task in geological investigations involving the appraisal of natural resources and hazards is the establishment of a three-dimensional geological model using subsurface data. The plotted isopach maps for the Jeribe, Dhiban, and Euphrates formations in the Ajeel structure indicated the existence of paleo-highs during the deposition of each of the mentioned formations indicating the structure had been continuously growing at least since the lower Miocene, where the Euphrates Formation was depositing. The porosity at the NW plunge of the structure is the lowest for the top of the three studied formations, and it is highest near the crest of the structure for the top of the two formations of the Jeribe and Euphrates. The highest water saturations for the top of the Jeribe, Dhiban, and Euphrates formations to be at the SE plunge of the structure, and commonly, the lowest water saturation exists at the crest of the structure and starts increasing toward the western limb and the SE plunge. Based on the recorded formation pressure data and the computed Moveable Hydrocarbon Index (MHI), the depth of each of the Gas-Oil Contact (GOC), Transition Zone (TZ), and Oil-Water Contact (OWC) for the Tertiary reservoirs in the Ajeel Oilfield has been detected. Pressure data of the well Aj-6; appeared the GOC at a depth -873m, whereas the OWC is believed to be at a depth of about -967m in the southern dome of the field. The estimated closure from the top of the Tertiary reservoirs (top of the Jeribe Formation) was about 395m for Jeribe reservoir, 445m for the Jeribe and Dhiban reservoirs together, and 460m for the three reservoirs of the Jeribe, Dhiban, and Euphrates collectively. Accordingly, the Jeribe Formation looks to be full of hydrocarbons until its spill point, whereas both the Dhiban and Euphrates formations are partially filled with hydrocarbons, and there are still parts of them within the closure that are full of water and represents part of the aquifer in the field.

Keywords: Ajeel Oilfield, Geological modeling, Hydrocarbon moveability, Tertiary reservoirs.

GK6- 90

Productivity assessment for the unit a of the upper Triassic Kurra Chine Formation from a well in Bina Bawi oilfield, Iraqi Kurdistan region

Dler. H. Baban[1*] and Mustafa M. Ahmad[2]

[1] Department of Earth Sciences and Petroleum, Sulaimani University, Sulaimaniyah, Kurdistan Region-Iraq

[2] Department of Petroleum Geosciences, Soran University, Erbil, Kurdistan Region-Iraq

[*] dler.mohamad@univsul.edu.iq

Abstract

The Unit A of the Triassic Kura China Formation has been studied from a reservoir characterization point of view in the selected BB-4 well of Bina Bawi Oilfield, Iraqi Kurdistan Region, to identify its productive potential. The study is done based mainly on the available full sets of wireline log data for the gross penetration of 323m of the unit. The lithology was identified depending on the data from the porosity logs and appeared to be mainly composed of dolomite, anhydritic dolomite, and anhydrite with rare limestones. The data from the Gamma ray indicated low shale content (less than 10%) at the upper part of the unit, whereas at the middle and lower parts, shaly and shale intervals are common. The existing shale in the studied Unit A is mostly distributed as dispersed clay materials between the grains. The porosity of the unit was evaluated depending on the calculated corrected Neutron-Density combination log and showed that the unit is of poor porosity, being on average less than 5%. The permeability in the BB-4 well was obtained from the data of the Nuclear Magnetic Resonance (NMR) log and showed a lot of impermeable or poor permeable horizons. Three reservoir units were identified for the studied unit depending on the variations in the shale content, porosity, and permeability values. Hydrocarbons with different saturation percentages existing along Unit A of the Kurra Chine Formation in the studied well, and most of the existed hydrocarbons are non-movable (residual hydrocarbons). The calculated net to gross (N/G) reservoir, pay, and productive ratios for the studied Unit A collectively in the well BB-4 appeared to be 10.5%, 4.6%, and 4.6%, respectively.

Keywords: Kurra Chine, Bina Bawi, Reservoir Units, Movable hydrocarbons.

GK6- 92

Satellite-Derived Shallow Water Depths Estimation Using Remote Sensing and Artificial Intelligence Models, A Case Study: Darbandikhan Lake Upper, Kurdistan Region, Iraq

Arsalan A. Othman[1,2*], Salahalddin S. Ali[3], Ahmed K. Obaid[4,5], Sarkawt G. Salar[6], Omeed Al-Kakey[7], Younus I. Al-Saady[8], Sarmad D. Latif[3,9], Veraldo Liesenberg[10], Silvio Luís Rafaeli Neto[11], Fabio M. Breunig[12] and Syed E. Hasan[13]

[1] Iraq Geological Survey, Sulaymaniyah Office, Sulaymaniyah 46001, Iraq

[2] Petroleum Engineering Department, College of Engineering, Komar University of Science and Technology, Sulaimaniyah, 460013, Iraq

[3] Civil Engineering Department, College of Engineering, Komar University of Science and Technology, Sulaimaniyah 46013, Iraq

[4] Department of Geology, University of Baghdad, Al-Jadiryah Street, Baghdad, Iraq

[5] Department of Earth Sciences, University of Durham, Durham, UK, DH1 3LE

[6] Department of Geography, College of Education, University of Garmian, Sulaymaniyah 46021, Iraq

[7] Institute of Geology, TU Bergakademie Freiberg, 09599 Freiberg, Germany

[8] Iraq Geological Survey, Al-Andalus Square, Baghdad 10068, Iraq

[9] Scientific Research Center, Soran University, Soran, Erbil, Kurdistan Region, Iraq

[10] Department of Forest Engineering, Santa Catarina State University (UDESC), Lages, SC 88520-000, Brazil

[11] Department of Environmental Sciences, Santa Catarina State University (UDESC), Lages, SC 88520-000, Brazil

[12] Department of Geography, Federal University of Paraná (UFPR), Curitiba, PR 80610-290, Brazil

[13] Department of Earth & Environmental Sciences, School of Science and Engineering,University of Missouri, Kansas City, MO 64110-2499, U.S.A

*arsala.aljaf@gmail.com

Abstract

Bathymetric mapping provides valuable information for the estimation of the depth and volume of enclosed inland water bodies that are useful in the planning and management of water resources. The use of conventional methods for the detection of shallow water depth, specifically in flooded areas, has been challenging. However, advances in remote sensing technology combined with artificial intelligence (AI) offer a reliable method. This study presents a reliable method to estimate water depth, using the Darbandikhan Lake Upper (DLU) as a test site. The novelty of this work lies in using a combination of Quantile Regression Forests (QRF), Random Forest (RF), Support Vector Machine (SVM), and Artificial Neural Networks (ANN) approaches together with the reflectance of Sentinel-2 and the ICESat-2 LiDAR data to estimate the depth of the water in the DLU during the 2019 spring flood. Our results gave the coefficient of determination (R^2) and root mean square error (RMSE) between the actual depth obtained from the ICESat-2 and the estimated depth from the applied artificial intelligence models of 0.984, 0.983, 0.868, and 0.809; and 0.545, 0.569, 1.618, and 2.143 for the QRF, RF, SVM, and ANN models, respectively. This study, which applied the QRF model for the first time for determining

the satellite-derived water depths, produced the most accurate result with the maximum and mean estimated depth of DLU being 19.93 and 6.29 m, respectively. This study shows that the most sensitive bands to estimate the bathymetry are Band 9 (940 nm), Band 3 (560 nm), and Band 5 (705 nm) of the Sentinel-2, while the less sensitive bands are Band 2 (490 nm) and Band 11 (1610 nm). We argue that this technique can be applied to estimate the depth of shallow water bodies using passive satellite imageries in other regions of the world regardless of the full coverage availability of ICESat-2.

Keywords: Artificial intelligence; Quantile Regression Forests; Random Forest; Support Vector Machine; Artificial Neural Networks; Satellite-Derived Bathymetry; SDB.

GK6- 96

The discrimination of paleo-exposure surfaces at the Sarvak Formation in a giant oil field, Abadan plain, SW Iran: An integrated approach

Ali Asaadi[1*], Javad Honarmand[2], Ali Imandoust[3], Aref Shamszadeh[1] and Behzad Soltani[1]

[1] Department of Geoscience, Tehran Energy Consultants (TEC), Tehran, Iran

[2] Research Institute Petroleum Industry (RIPI), Tehran, Iran

[3] Department of Geoscience, Kish Petroleum Engineering (KPE), Tehran, Iran

[*] a.asaadi@tehranenergy.com

Abstract

Rudist bearing strata of the Upper Cretaceous Sarvak Formation and equivalent units host important hydrocarbon reservoirs in the Zagros basin and Arabian Plate. The recognition of the disconformity surfaces is a crucial step on accurate reservoir characterization. This study examines the paleo-exposure surfaces within the Sarvak Formation by integrating the core, thin-section, scanning electron microscopy, X-ray diffraction, carbon-oxygen, and spectral gamma ray signature from some key wells in giant oil field at the Abadan Plain oil fields. In the upper part of the Sarvak Formation, two main phases of emergence originated from eustatic changes and movements of basement blocks, which detected via diagenetic features such as solution-collapse brecciation, Ferroan pisolite, iron oxide and development of palaeo-soil horizons. These pronounced disconformities were recorded at the Cenomanian–Turonian boundary (CT-disc) and the middle Turonian (MT-disc) time scale. The Cenomanian-Turonian boundary is coincided with a high eustatic level span and development of disconformities during this time are mainly due to regional tectonic activity. In contrast, the mid-Turonian disconformity, coincided with a significant eustatic sea-level fall, also formed during time of regional tectonic events (starting of the ophiolite obduction resulted from closure of the Neo-Tethys). This surface originated from combination of both eustatic sea level fall and tectonic activity. Both discontinuity surfaces in spectral Gamma ray

log and ratio of radioactive elements show evidence of uranium depletion, which is related to the occurrence of meteoric diagenesis processes. The $\delta^{13}C$ and $\delta^{18}O$ values indicated heavy meteoric diagenesis beneath the disconformity surfaces. Cross plots of $\delta^{13}C$ vs. $\delta^{18}O$ showed inverted-J patterns, indicating a high meteoric diagenesis effect. The identified clay minerals in the Sarvak reservoir are including the montmorillonite, kaolinite, illite and chlorite, which montmorillonite is the most common clay mineral and revealed a frequency peak at disconformity surfaces. Montmorillonite frequency is interpreted to be results of palaeo-soils development at the exposure surfaces which are derived from extensive meteoric diagenesis. Regarding with high reservoir potential of the Sarvak Formation in the Abadan plain, detection and interpretation of the main disconformity surfaces is of significant importance for efficient reservoir characterization.

Keywords: Sarvak, Abadan Plain, Paleo-exposure surfaces, diagenesis, Spectral Gamma Ray.

GK6- 98

Morphotectonic indices of some geological structures -Northern Iraq

Alaa N. Hamdon[1*], Rabeea Kh. Znad [2], Hadeer Gh. M. Adeeb [3] and Mohammad F. O. Khattab [4, 1]

[1] Remote Sensing Center, University of Mosul, Mosul, Iraq

[2] Department of Geology, College of Science, University of Mosul, Mosul, Iraq

[3] Dams and Water Resources Research Center, University of Mosul, Mosul, Iraq

[4] Remote Sensing Center, University of Mosul, Mosul, Iraq

[*] alaa.hamdon@uomosul.edu.iq

Abstract

An expressive, factual, informative, and concise abstract is required. A single paragraph no more than 300 words maximum. Landforms respond to geological deformation caused by active tectonics in various ways depending on the rate and amount of surficial deformation and on the type of landforms. On the basis of visual interpretation results by remote sensing techniques, virtual models of landforms response to the active tectonic deformation represented by (anticlinal uplift with a deformation in the surrounded landforms and strike-slip faults) have been demonstrated in this study. Natural hazards are mostly related to the activation of combined geomorphological and geological processes that control landforms and its development.The study areas are exciting in Nineveh and Kirkuk which are located in the Northern part of Iraq. This study demonstrates the benefits from the compilation between the different remote sensing data in order to highlight the effecting of active tectonic on land forms in the study areas. These data give different and complementary information to extract the evidences of the active tectonic and then

drawing it on a thematic map. Then, analyze and interpret these evidences to manifest the effect of the active tectonic on the land forms. The application presented here was focused on the uplift deformation, strike-slip faults depiction and the interpretation of the drainage pattern's response to the active tectonic and then mapping and highlighting of the landform geomorphology in the study areas.The results of this study shows the effective of active tectonic on the landforms in the study area, through segregating some morphotectonical features or landforms representing the active tectonic (Tectonic uplift and strike-slip fault).

Keywords: Morphotectonic Indices; Structures; Northern Iraq.

GK6- 99

Stratigraphy, sedimentology and source rock evaluation of the Baluti Formation, Sirwan Gorge and Kawlos area, Kurdistan Region NE Iraq

Sirwan H. Ahmed[1 *], Asaad I. Mustafa[1], Barween O. Qader[1], Ibrahim M. J. Mohialdeen[1] and Polla A.Khanaqa[2]

[1] Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Sulaimani city, Iraq

[2] Department of Geology, Kurdistan Institution for Strategic Studies and Scientific Research, Sulaimani city, Iraq

[*] sirwan.ahmed@univsul.edu.iq

Abstract

The Baluti Formation from the Sirwan Gorge, and Kawlos area, Kurdistan Region, NE Iraq, is an essential stratigraphic unit within the Triassic-Jurassic sequences of the region, offering valuable insights into the geological history shaped by the collision of the Arabian and Eurasian plates. This study provides a comprehensive analysis of the formation's stratigraphy, sedimentology, and source rock potential, emphasizing its significance within the broader tectonic context. Extensive fieldwork conduct across two principal sections in Halabja and Kawlos areas to document and analyze lithofacies. This included detailed stratigraphic logging and petrographic analysis to delineate microfacies and interpret depositional environments. Rock-Eval pyrolysis perform on 19 samples to evaluate the total organic carbon (TOC wt.%) content, kerogen type, and thermal maturity, thereby assessing the hydrocarbon generation potential of the formation. The study areas are locating in the imbricate and highly folded tectonic zones of northeastern Iraq. Detailed fieldwork and lithofacies analysis identified the formation as a key marker within the Triassic-Jurassic sequences, comprising primarily marl and silicified limestone. Two main sections were studied, revealing significant differences in lithofacies composition and thickness compared to the type section in northern Iraq. Rock-Eval pyrolysis analysis indicated to low organic matter richness, with Total Organic Carbon (TOC) values ranging from 0.09% to 0.71%. The samples predominantly contain Type IV kerogen, suggesting limited potential for hydrocarbon generation. The thermal maturity analysis showed that the upper part of the

formation is immature, while the lower and middle parts are post-mature. Petrographic analysis identified six distinct microfacies, which were grouped into two facies associations: restricted lagoonal (intertidal) and open circulation lagoon. The identified microfacies reflect deposition in shallow marine environments with varying energy levels and circulation patterns. The Baluti Formation's depositional environment, characterized by lagoonal settings with episodic supply of siliciclastic material, points to a restricted and low-energy setting with periodic high-energy events. Overall, the Baluti Formation, despite its limited source rock potential, provides valuable insights into the paleoenvironmental conditions and tectonic history of the region during the Late Triassic. This study enhances the understanding of the stratigraphic framework and sedimentological characteristics of the Triassic-Jurassic successions in the Kurdistan region of Iraq.

Keywords: Baluti Formation, Source Rock Evaluation, Kurdistan, Triassic, and Microfacies

GK6- 100

Biostratigraphy of the Aaliji Formation, Duhok Area, Kurdistan Region, North of Iraq

Halbin M. Abdulwahid * and Zaid A. Malak

Department of Geology, College of Science, University of Mosul, Mosul, Iraq

* helbeen.muhammed@gmail.com

Abstract

The Aaliji Formation offers a valuable record for the understanding of the Early Paleocene biostratigraphy based on the planktic foraminiferal assemblage. The Danian sediments of the formation spans from approximately 66 to 61.6 Ma ago and well-exposed at the Bade section in the Bekhair anticline of the Duhok area of the Kurdistan Region, north of Iraq. 37 fresh samples from the Aaliji Formation, along with additional samples from the underlying Shiranish Formation and the overlying Kolosh Formation were collected. The processed thin sections were analyzed using Polarized Light Microscopy (PLM) to identify and classify the planktic foraminifera. Four main biozones and three subzones of the Danian age were identified, including the *Guembelitria cretacea* P0 Partial Range Zone, *Parvularugoglobigerina eugubina* Pα Total Range Zone, *Parasubbotina pseudobulloides* P1 Interval Zone (*Globoanomalina archaeocompressa* P1a Partial Range Subzone, *Subbotina triloculinoides* P1b Interval Subzone, *Globanomalina compressa* – *Praemurica inconstans* P1c Interval Subzone), and *Praemurica uncinata* (P2) Interval Zone. This study confirms the presence of the Danian age in the Aaliji Formation and establishes the biostratigraphic framework through correlation with previous regional and global studies. These findings enhance the understanding of Early Paleocene foraminiferal assemblages in Northern Iraq and contribute to the general context of early Cenozoic biostratigraphy.

Keywords: Biostratigraphy, Aaliji, Danian, Duhok, Iraq.

GK6- 102

Evaluation of Groundwater Resources Management of Bashtapa Sub-basin, Erbil, KRG-IRAQ

Sarkhel H. Mohammed[1,2,3,*], Yetzabbel Flores[2], Mikita Viktoria[2], Balazs Kovacs[2], Diary A. M. Al Manmi[4] and Peter Szucs[2,3]

[1] Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Sulaimani, Iraq

[2] Institute of Water Resources and Environmental Management, University of Miskolc, Miskolc, Hungary

[3] National Laboratory for Water Science and Water Security, University of Miskolc, Institute of Water Resources and Environmental Management, Miskolc

[4] Technical College of Engineering, Sulaimani Polytechnic University, Iraq

[*] sarkhel.geo@gmail.com

Abstract

Groundwater is a vital natural resource which all human being depends. Recently, due to less vulnerability compared to surface water, the agricultural, industrial, human residential area growing fast in Southern Erbil city of Bashtapa sub-basin, besides the climatic condition is semi-arid characterized by high rate of evaporation and evapotranspiration with decreasing rainfall depth to below the average level in some periods of the year. The goal of this research is to evaluate the groundwater flow regime in the entire basin in order to upgrade the groundwater management in the area, toward sustainable water resource management for living bodies. The improper management and less accurate number of wells led to this study facing difficulty in identifying the hydrogeological framework of the area. This research uses the Groundwater Modeling System to have better understanding of the sub-basin, another point is to see how the Lesser Zab River which is located in the southern boundary of the basin affects the groundwater by supplying through geological units. As findings, we found that the model calculated heads fit with the spatial distribution of water level rather than the initial head, it can be interpreted as that the initial head which is recorded from the wells not the real water table it can be the result of hydraulic window of the entire hydrogeological units. At the same time, the result reveals that the wells are screened incorrectly behind the study limitation which includes data quality of hydrogeological data (screen, lithology description, time period's). Moreover, the results gives a robust interpretation for the local authority, policymakers to achieve sustainable water resources management in Bashtapa sub-basin

Keywords: Numerical Modeling, GMS, Groundwater management, Bashtapa.

GK6- 103

Assessment of the Effects of Geological and Human Activity on Rare Earth Elements in Stream Sediments along the Rawanduz River Course from the Haji Omeran area to the Greater Zab River Intersect, Kurdistan Region, Iraq

Hikmat S. Al-Jaleel

Earth Sciences and Petroleum Department, Salahaddin University, Erbil, Kurdistan Region, Iraq

hikmatsafi@gmail.cm

Abstract

The study focused on assessing rare earth elements (REEs) contamination in Rawanduz stream sediment in Iraq's Kurdistan Region. Twenty-seven stream sediment samples (>80-mesh) underwent rigorous analysis via Inductively Coupled Plasma-Atomic Emission Spectrometry (ICP-AES). REE concentrations in the sediment closely mirrored those of the Upper Continental Crust (UCC), with a predominance of Light REEs (LREEs) over Middle (MREEs) and Heavy REEs (HREEs), consistent with typical UCC patterns, suggesting similar geological origins. The study area was divided into four districts—Haji Omeran-Omarawa, Nawgaelan-Parde Bengaelan, Barsarin-Balakyan, and Maran-Sawa—based on REE behavior similarities. Haji Omeran-Omarawa and Barsarin-Balakyan exhibited higher Ce and Nd levels, while Nawgaelan-Parde Bengaelan showed elevated Pr, Sm, and Tb, and Maran-Sawa displayed increased La, Pr, and Dy concentrations. Chondrite-normalized REE patterns indicated gradual slopes with LREE enrichment and weak negative Eu anomalies in Haji Omeran-Omarawa and Barsarin-Balakyan, implying natural geological sources. Conversely, Nawgaelan-Parde Bengaelan and Maran-Sawa showed erratic patterns with weak negative Ce anomalies and strong positive Eu anomalies, indicating fractionation processes and MREEs enrichment relative to LREEs and HREEs. Geo-accumulation index (Igeo) classified most samples as unpolluted, except for Pr, Sm, Eu, and Tb in Nawgaelan-Parde Bengaelan, and Pr, Eu, Tb, and Dy in Maran-Sawa, which showed low to very low pollution levels. The Potential Ecological Risk Index (RI) categorized REEs in Haji Omeran-Omarawa and Barsarin-Balakyan as low risk, whereas those in Nawgaelan-Parde Bengaelan and Maran-Sawa posed moderate risks. Anomalies in REE distribution were linked to weathering and hydrodynamic sorting processes, exacerbated by slow river flows and gravel extraction activities. Factor analysis revealed four main factors explaining 81.84% of variance, with Factors 1, 2, and 3 encompassing LREEs, MREEs, and most HREEs from natural sources. Factor 4, influencing HREEs like Yb, accounted for 6.49% of variance, suggesting anthropogenic influences on REE distribution.

Keywords: Rawanduz, Pollution, REE, Assessment, Stream sediments.

GK6- 104

Geochemical comparison between the carbonates of Pila Spi Formation and those of Conglomerate unit separating it from Gercus Formation, Kurdistan Region northeastern Iraq

Farhad A. Mohammad

Department of Earth Sciences and Petroleum, College of Science, Salahaddin University, Erbil, Kurdistan Region, Iraq

farhad.mohammad@su.edu.krd

Abstract

The clastic unit which separated Gercus and Pila Spi Formations dominated by conglomerate. This conglomerates are formed by pebbles of vari-colored limestone and chert cemented by carbonates and clay with silt. The relation of clastic unit with the two surrounding Formations is not clear and arguable as it is considered conformable according to some studies and unconformable according to others. to clarifying this relation and attempt to determining sources of this conglomerate the geochemistry study done. Twenty One samples of limestone rock and limestone pebbles (9 Pila Spi limestone rock and 12 clastic unit limestone pebble) were collected from four sections, Darbandi Gomaspan, Chneran, Darbandi Shaqlawa, and Basirma. The samples were analyzed by ICP-MS (Inductive Coupled Plasma Mass Spectrophotometer) in ALS laboratory group at Seville in Spain to thirty six elements for their major and trace elements geo-chemistry. in addition to six cement material samples collected from conglomerates of clastic unit to mineralogical studies by XRD**.** geochemistry analyses show high degree of similarity in chemical composition of clastic unit carbonate pebbles and those of Pila Spi Formation rocks. The carbonate pebbles clasts can be considered as early deposited sediment parts of Pila Spi Formation.

Keywords: BASIRMA; carbonate pebbles; clastic unit; derbindi Shaqlawa.

GK6- 105

Microfacies and Biostratigraphy of the Middle Turonian-Middle Campanian succession, Hizop Section, Dokan Area, Northeast of Iraq

Zahid Gardy*, Mushir Baziany and Sirwan Ahmed

Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, KRG-Iraq

* zahidgardy@gmail.com

Abstract

The biostratigraphy and microfacies analysis of the carbonate succession at the Hizop section investigated. Lithostratigraphically, this succession is composed of stylolitic beds of tough limestone rich of chert nodules and iron oxides of the Kometan Formation, that overlies by the

light brown marly limestone and shale of the Shiranish Formation. The petrographic analysis shows two main microfacies from the Kometan Formation; Bioclastic packstone, Glauconitic bioclastic lime packstone to grainstone, with three microfacies from the Shiranish Formation; *Globigerinoides* wackestone-packstone, *Globigerinoides* packstone, and foraminiferal packstone-grainstone. Biostratigraphic investigations proposed four main biozones; *Muricohedbergella holmdelensis* Interval Zone, *Dicarinella hagni* Partial Range Zone, *Globotruncanita elevata* Partial Range Zone, and *Globotruncana ventricosa* Interval Zone. These proposed biozones indicating Middle Turonian – Lower Santonian age for the Kometan Formation, and Lower-Middle Campanian for the Shiranish Formation, suggesting a gap of Middle-Late Santonian which mark an unconformity between these two rock units in the studied Hizop section of the Dokan area.

Keywords: Kometan, Shiranish, Microfaceis, Dokan, Iraq.

GK6- 106

Geochemical characteristics of the lower and upper Triassic carbonates from Mirga Mir and Baluti formations, Kurdistan Region, Iraq

Faraj H.Tobia [*], Baran H. Mustafa, Ahmid M. Aqrawi

Department of Earth Sciences and Petroleum, Salahaddin University, Erbil, Kurdistan Region, Iraq

[*] Farajabba58@gmail.com

Abstract

The carbonates of lower (Mirga Mir Formation) and upper (Baluti Formation) Triassic, Kurdistan Region, Iraq were geochemically investigated to interpret sources of the rare earth elements (REEs), provenance, and depositional environments based on major, trace, and rare earth elements geochemistry. The predominance of CaO and the low percentage of MgO in the two sections of Mirga Mir (Nazdur and Beduhe) and Sararu section of Baluti suggest that mineral phase is calcite; in contrast, the dominance of MgO in Sarki section indicates the intensive dolomitization. Sr is a dominated over the other elements in all studied carbonates, and P2O5 is enriched in Sararu carbonate relative to PAAS. The positive correlation of ΣREE with Al2O3, Fe2O3, K2O, TiO2, P2O5, Hf, Th, V, Zr, Y, and Cu, suggest the association of the REEs with clay and heavy minerals in both Triassic carbonates. Additionally, the MREE bulge patterns suggest the role of their scavenging on iron oxides/ hydroxides. However, the negative correlation of REEs with the MgO in Baluti carbonates reflect the negative effect of the dolomitization on the REE contents and some amounts of the latter are related to the original seawater carbonates due to their positive correlation with CaO and Sr. Most of the analyzed samples show slightly negative Ce anomalies (Ce/Ce* = 0.988 and 0.984 for the lower and upper Triassic, respectively), and relatively positive Eu anomalies (1.007) for lower Triassic and slightly negative Eu anomalies (0.995) for upper Triassic carbonate. Positive Eu anomalies might be caused by the contamination of

seawater-like signatures by detrital materials which mask the original signature of the seawater. The low values of the Y/Ho ratio for the lower and upper Triassic (30.06 and 31.59, respectively) relative to marine water and approach of Ce anomaly to 1.0 refer to increasing the clastic flux from the adjacent continent and freshwater intrusion to seawater during the precipitation of the carbonates. The low contents of Co and Cr, and from the La/Co, Th/Co, Cr/Th ratios, suggest that the detrital components of the carbonates originated from felsic source rocks with influence of mafic rocks. Authigenic U, Th/U, V/Cr ratios, and slightly negative Ce anomalies, indicate the deposition of the lower and upper Triassic carbonates under oxic conditions.

Keywords: Geochemical characteristic, Triassic, Kurdistan Region, Iraq, Rare earth elements.

GK6- 108

Petroleum Hydrodynamic of Oilfields in Basrah, Southern Iraqi

Heba S. Al-Mimar* and Salih M. Awadh

Department of Geology, College of Science, University of Baghdad, Baghdad, Iraq

* hiba.saadon@sc.uobaghdad.edu.iq

Abstract

Two and three models of fluid flow and hydrocarbon entrapments were constructed for the Mishrif Formation in Rumaila South (RU), Rumaila North (R), West Qurna (WQ), Majnon (MJ), and Zubair (ZB) oilfields in Basra, southern Iraq. The dynamic flow within the oil reservoir was analyzed by measuring the specific gravity, hydrostatic pressure, and oilfield water salinity. Fluid saturation in the pore space, capillary pressure, hydrodynamic parameters, density, permeability, and buoyancy influence fluid flow. The hydrodynamic model indicates that the oil fields are non-isolated reservoirs with a uniform pressure system. They are characteristic of an intermediate hydrodynamic environment between the WQ and R, a semi-static environment between R and RU, an extremely dynamic environment in the MJ oil field, and a moderately dynamic environment in ZB. Oil potential models demonstrate that fluid flow is influenced by reservoir pressure, resulting in the accumulation of hydrocarbons in specific locations. These locations include the R oil field, the northeastern half of the MJ oil field, and the western part of the ZB area. The Ru, MJ, and ZB oil fields exhibited anomalous pressure conditions likely caused by a permeable or localized barrier. Oil migrates from areas of high potential energy in the WQ and RU oil fields to the R fields, where potential energy is low in MJ. Conversely, in the Zubair field, oil flows in a northeast direction, descending along the inclined slope.

Keywords: Salinity; Potential map; Hydraulic gradient; Pressure; Permeability.

GK6- 109

Implications of tectonic activity on alluvial fan's morphometry: a case study in the Northeastern Dokan lake, KRG, Iraq

Hekmat S. Al-Daghastani [1,*], Lanja H. Abdullah [2] and Azhar Kh. S. Bety [2]

[1] Remote Sensing Center, University of Mosul, Mosul, Iraq

[2] Department of Earth Science and Petroleum, College of Science, University of Sulaimani, Sulaimanyah, Iraq

[*] hekmat.s.yousif@gmail.com

Abstract

The research aims to study and evaluate morphotectonic activity and track signs of deformation resulting from folding and faulting activity, which is reflected in the geomorphological features within the Bna Barek anticline, which is located within the High Folded Zone within the Sulaymaniyah Governorate, Iraqi Kurdistan Region. Based on many field trips, the sub-basins of the Khry Sraw and Marga valleys on sub-basins on the foothills of Bna Barek anticline in the northeast of Dokan Lake were chosen as a case study to evaluate tectonic activity by relying on several geomorphological indicators within the study area.This study relied on modern technologies represented by remote sensing and geographic information systems, as well as digital data with high spatial resolution, described by satellite images, a digital elevation model, and many field visits. Based on the terrain and rock characteristics, and based on the ITC classification, the area was divided into several geomorphological units, namely: Dokan Lake, Berm slope, Alluvial fan, River bed and terraces, Anticlinal erosional core, Foot slopes, Outer homoclinal ridges, Isolated remnant anticlinal ridges and Fault scarp. The study reached many results that can be summarized: The results of the study showed the behaviour demonstrated valley at the point where it crosses the upthrown side of a reverse fault demonstrates anomalies in both valley and channel characteristics, two distinctive physiographic regions, the first catchment region constitutes an anticlinal erosional core spanning from the headwaters near the outer homoclinal ridge to the uplifted wind gap along the fault scarp line. Topographic anomalies are evident across the main and modern channels on the Khry Sraw alluvial fan surface. A model for the stages of development of the alluvial fans during stream migration as a result of propagation of the fault on the Bna Barek anticline has also been built.

Keywords: Tectonic activity; Alluvial fan; Morphotectonic map, Dokan Lake.

GK6- 110

Identification of Sequence Stratigraphic Surfaces Using Petrophysical Logs: Implication for Petroleum System Elements; Case Studies from Siliciclastic and Carbonate Oil/Gas Reservoirs in Iran

Behzad Soltani[1,2,*], Ahmad R. Rabbani[3,4], Reza Mousavi-Harami[2], Ali Asaadi[1] and Aref Shamszadeh[1]

[1] Department of Geoscience, Tehran Energy Consultants (TEC), Tehran, Iran

[2] Department of Geology, Ferdowsi University of Mashhad, Mashhad, Iran

[3]Department of Petroleum Engineering, AmirKabir University of Technology, Tehran, Iran

[4] Department of Petroleum Engineering, University of Science and Technology of Mazandaran, Behshahr, Iran

[*] b.soltani67@gmail.com

Abstract

In many geological studies, the lack of continuous sedimentological data is a serious limitation in the sequence stratigraphic studies. The current study investigates the application of petrophysical well logs and their Dynamic Integrated Prediction Error Filter Analysis (D-INPEFA) curves to identify and correlate depositional sequences of the siliciclastic and carbonate oil/gas fields in different basins in northeastern and southwestern Iran.Based on the petrophysical well log including gamma-ray (GR), density (RHOB) and sonic (DT) curves in the available wells from different fields, spectral wavelet analysis by using the CycloLog software was conducted on the mentioned wireline logs. Through comparison of the INPEFA curves and their correlation, it is found that the spectral wavelet trend of wireline logs is associated with the variation in the sedimentary cycles in sedimentary basin. Given that the turning points of the obtained INPEFA curves, integrated with outcrop and cored-well data, the sequence boundaries and maximum flooding surfaces have been identified in the representative wells. Then, the determined sequence stratigraphic framework of the studied formations was developed throughout the wells lacking sedimentological data in the fields. In case of siliciclastic successions, the negative turning points of INPEFA curve indicates regressive surfaces (sequence boundaries), and the positive turning points represent transgressive surfaces (maximum flooding surfaces). Conversely, in carbonate strata, the negative and positive turning points of the INPEFA curve show transgressive and regressive surfaces. Therefore, the INPEFA curve can be applied as a useful approach in discriminating the transgressive systems tract (TST) and high-stand systems tract (HST) deposits, in localities lacking sedimentological data (outcrop, core, etc.).

Keywords: Sequence Stratigraphy, Petrophysical Logs, CycloLog, Integrated Prediction Error Filter Analysis (INPEFA).

GK6- 111

Effect of deep-seated structural elements in the basin evolution and petroleum system of the Mesopotamian Zagros Foreland Basin

Aref Shamszadeh[1*], Artabaz Adhamian[2], Maryam Jamalian[3], Iraj Abdollahiefard[4], Ali Asaadi[1] and Behzad Soltani[1]

[1] Department of Geoscience, Tehran Energy Consultants (TEC), Tehran, Iran

[2] Department of Geoscience, Petroleum Engineering and Development Company (PEDEC), Tehran, Iran

[3] Department of Geoscience, Petro Pars Ltd., Tehran, Iran

[4] National Iranian Oil Company Exploration Directorate, Tehran, Iran

[*] arefshams70@gmail.com

Abstract

The evaluation of basement/cover interface architecture in the Mesopotamian Zagros Foreland Basin (MZFB) is critical to understand its structural analysis and development over time. The Abadan plain as a part of the MZFB developed over heterogeneous crystalline basement topography with alternating horsts and grabens. In this work, we have determined and delineated these deep-seated lineaments by their effect on the good-quality 3D seismic data, seismic attributes, 3D sequential restoration, isopach maps and facies variation. Accordingly, the geometry of sedimentary basin was influenced by repeated reactivation of deepseated (probably basement-rooted) faults at least since the Permian. Long history activity of the faults significantly controlled the thickness and facies variations of the Lower and Upper Cretaceous petroleum systems, i.e. Cretaceous Garau-Fahliyan and Kazhdumi-Sarvak units, respectively. In addition, the reactivation of these basement-rooted structures and their impact on the sedimentary cover played an even greater role in the fracturing and reservoir enhancement along them. The huge oil production comes from the deep Fahliyan reservoir resulting from fracture-related permeability along underlying NW-SE basement-rooted faults. Approaching the MZFB, the oilfields are first elongated in N-S trending and then become circular, to elongate with the NW-SE trending which are mainly controlled and relocated by the deep-seated structures during the Zagros deformation. Here, we emphasize the role of three main groups includes, the N-S, NESW and NW-SE trending facies boundaries and structural elements attributed to Pan-African suture (670– 570 Ma), Najd fault systems (550–540 Ma), and the opening of the Neo-Tethys ocean, respectively. These basement-rooted faults are prevented from rupturing the surface by the multiple evaporite layers (e.g. the Hurmoz, Dashtak and Gutnia formations) within the sedimentary cover. It is concluded that the interaction between the different regional stress field during the Phanerozoic and the pre-existing basement structures controlled the structural irregularity and complexity in the MZFB. The interpretation of the seismic data support that, the N-S-trending Pan-African structure transected, displaced and segmented by repeated reactivation of the NW-SE-trending and NE-SW-trending structures highly during the Late Jurassic and Late Cretaceous times, respectively.

Keywords: Deep-seated Fault, Basement, Zagros, Mesopotamian Foreland basin, Seismic.

GK6- 116

Geospatial Modeling of Groundwater Potential Zones using Integration of RS, GIS, and AHP approaches validated by Electrical Resistivity Tomography in New Halabja District, Sulaymaniyah, NE of Iraq

Hawber A. Karim[1, *], Sarkhel H. Mohammed [1,2, 3], Bakhtiar Q. Aziz[1], Diary A. M. Al-manmi[4] and Péter Szűcs[2, 3]

[1] Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Sulaimani, Iraq

[2] Institute of Water Resources and Environmental Management, University of Miskolc, Miskolc, Hungary

[3] National Laboratory for Water Science and Water Security, University of Miskolc, Institute of Water Resources and Environmental Management, Miskolc

[4] Technical College of Engineering, Sulaimani Polytechnic University, Iraq

[*] hawber.karim@univsul.edu.iq

Abstract

Groundwater resources are essential for all living organisms, necessitating effective management techniques grounded in scientific principles. This study assesses the geospatial modeling of groundwater potential areas using a multi-parameter decision approach, specifically the Analytical Hierarchy Process (AHP) in the New Halabja area. To ensure the robustness and reliability of the identified potential zones, geoelectrical data were utilized for validation purposes. The data obtained, including remote sensing (RS), well profiles, hydraulic tests, and geo-electrical surveys, were integrated into a Geographic Information System (GIS) environment. The AHP modeling incorporated eight groundwater conditioning factors: geology, rainfall, slope, lineament density, drainage density, soil, land use andland cover (LULC), and Topography. These factors were ranked based on their importance to groundwater potential and weighted using pair-wise comparison matrix analysis. The weighted sum function in GIS was employed to overlay all layers and their associated weights. The results identified three groundwater potential zones (GWPZs): poor, moderate, and very high potential. The total area covered 269 km², with 21% classified as poor, 17% as moderate, and 62% as good potential sites. Furthermore, the verification process was conducted using hydro-geophysical approaches. Geoelectrical survey lines, obtained using a SYSCAL R1 plus instrument, were interpreted using the software packages RES2DINV and IPI2win. The interpretation results indicated that the resistivity of the aquifer in the area ranged between 10 and80 ohm.m, revealing two distinct aquifer layers at different depths with lateral variations and lithological lenses. The shallow aquifer depth ranged from 10-20 m, while the deeper one started beyond 40 m . The aquifers consisted of gravel and sandstone mixed with sand, silt, and clay, corroborating the water well profiles. The study concluded that groundwater potential mapping using the AHP model is a reliable technique for semi-arid areas,

with the geo-electrical results closely aligning with the AHP model outcomes. These findings provide valuable insights into the hydrogeological characteristics of the area, offering a robust understanding of groundwater issues that can inform strategic planning by decision-makers and stakeholders.

Keywords: **Groundwater potential,** Electrical resistivity tomography, AHP, Geospatial Modeling.

GK6- 117

Comparative study of metal contamination and ecotoxicology in soils near Sisak ironworks (Croatia) and Sulaimani steel plant (Kurdistan region, Iraq)

Željka Fiket[1, *], Ivan Antičević[1], Marta Popović[1], Antonela Blažević[1], Maja Ivanić[1], Neda Vdović[1], Roshna A. Hamarashid[2] and Ibrahim M. J. Mohialdeen[3]

[1] Division for Marine and Environmental Research, Institut Ruđer Bošković, Zagreb, Croatia

[2] Environmental and Health Division, General Directorate of Education, Ministry of Education, Kurdistan Regional Government, Iraq

[3] Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Sulaymaniyah, Iraq

*zeljka.fiket@irb.hr

Abstract

Iron and steel have been central to human civilization for thousands of years and, along with coal and cotton, formed the backbone of the industrial revolution. These materials are still indispensable in many industries. However, the iron and steel industry face significant environmental challenges as it is responsible for around 10% of global energy-related CO2 emissions and a quarter of all industrial CO2 emissions. In addition, the regions surrounding steel and iron smelters are often exposed to high levels of pollution, highlighting the need for further research to understand the full extent of their environmental impact. This study, therefore, investigates the impact of the Sisak ironworks (Croatia) and the Sulaimani steel plant (Kurdistan Region, Iraq) on the surrounding soils, focusing on their geochemical composition, textural properties and toxic effects. Our aim was to compare a multi-parametric datasets on the soils in these areas, including their physicochemical properties, grain size distribution, multi-element composition, bioavailable fraction, and cytotoxic effects. Specifically, the new data for the soils surrounding the Sisak ironworks was compared with the existing data for the soils surrounding the Sulaimani steel plant, and complemented by the study of the metal and metalloid content in the soil eluates and the assessment of cytotoxicity using the MTT assay. The obtained results showed statistically significant differences in grain size distribution and metal(loid) content between Sisak and Sulaimani soils (for all elements except K, P, Sr, Ti, V and Y). These differences were somewhat expected due to the different geology and pedology of the study areas. Despite the differences in total concentrations, some enrichment patterns were similar. The soils in Sisak

ranged from uncontaminated to heavily contaminated with As, Cd, Mo, and Ni, and in certain areas with Cr, Cu, Fe, Sb, Tl, V and Zn. The enrichment pattern depended primarily on the proximity to the ironworks. In Sulaimani, contamination levels were also reported variable, with more pronounced contamination towards the north and east, i.e. heavy contamination by Cr, Ni and Pb, and moderate contamination by As, Co, Cu, V and Zn, compared to south and west. These results indicate that activities in the vicinity of steel and iron plants significantly increase metal(loid) levels in the soils and alter their textural properties, which in turn had also a noticeable effect on cell viability.

Keywords: industrial pollution, soil, soil eluates, leaching, bioavailable fraction, MTT assay.

GK6- 118

The effect of basement relief on the shallow structures and courses of rivers in the Mesopotamian zone, the southern part of Iraq

Laith S. Abd* and Ali M. Al-Rahim

University of Baghdad, College of Science, Department of Geology, Baghdad, Iraq

* laithsabahabd68@gmail.com

Abstract

The potential field data (Gravity and Magnetic) play a dominant role in geophysics exploration, especially in studying structures that are distributed in different depths ranging from basement to shallower. In the present study, a basement map was prepared using the SPI (Source Parameter Imaging) method to the magnetic data (RTP map) to show the topography of the basement and how its effect in the structures suited in sedimentary cover by folding and faulting and generations of main structural trend, in addition, explain the relation between the changing of coarse rivers and shallow structures. Besides the magnetic data, the gravity data (Bouguer map) was used to extract a residual map that illustrates the sedimentary structures and linked with the oil field distribution map to show the effect of density contract on the structural petroleum traps. The result of this study shows the effect of basement relief surface (basement blocks) in the sedimentary cover and reach the Earth's surface by shifting the river's course near the faulting and folding area and distribution of oil fields in specific trends and systematic arrangements which related to the structures of the study area.

Keywords: Gravity; magnetic; basement; Mesopotamian; SPI; Rivers; residual map.

GK6- 119

Evaluation of Heat Generation by Radioactive Elements in Jurassic and Cretaceous Successions of the Zagros Belt, Northern Iraq

Fouad M. Qader

Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani

fuad.qadir@univsul.edu.iq

Abstract

This study presents data on radioactive heat generation (RHG) from Jurassic and Cretaceous successions in selected wells along the Zagros belt in Northern Iraq. A total of 2,600 meters of rock intervals were analyzed, encompassing all Jurassic and Cretaceous successions within the conjugated zone of the High and Low Folded zones. RHG values were obtained from uranium, thorium, and potassium concentrations, measured using Gamma Ray Spectrometry and Normal Gamma Ray logs. These measurements reflect the RHG resulting from the decay of uranium-radium series isotopes (U^{238}, U^{235}, and U^{234}), the Th^{232} series, and the primary decay of K^{40}. In the Jurassic section, the heat generation rate ranges from 1.51 µW/m³ in the upper part of the Butmah Formation to 5.52 µW/m³ in the Naokelekan Formation. In the Cretaceous section, it varies from 0.77 µW/m³ in the Kometan Formation to 1.48 µW/m³ in the Sarmord Formation. The contribution of these RHG rates to the subsurface temperature is approximately 2.60 mW/m² for the Jurassic section and 1.54 mW/m² for the Cretaceous section. These findings can be applied to evaluate how lateral variations in RHG rates influence heat flux and temperature distribution within the upper crust and sedimentary basins, particularly in terms of radioactive heat flow (RHF).

Keywords: Radioactive heat generation; Heat flow; Geothermal gradient.

GK6- 120

Diagenetic impact on porosity types of Middle-Late Eocene carbonate rocks aquifer (Pila Spi Formation) in Bjeel area, High Folded Zone, Iraqi Kurdistan region

Irfan Sh. Asaad*, Mohammed S. M. Hassan and Saeed I. Hussain

Department of Earth Sciences and Petroleum, College of Science, Salahaddin University- Erbil, Erbil, Kurdistan Region, Iraq

*irfan.asaad@su.edu.krd

Abstract

The porosity and diagenetic processes affected on the carbonate rocks of the Middle-Late Eocene Pila Spi Formation in the Khanaga section, Bjeel area, are studied in detail. The total thickness of the formation is 37.5 m, comprised of fractured limestone, marly limestone, and

dolomitic limestone with thin beds of marl and mudstone characterized by karstic fissures and pores. The petrographic analysis of 25 thin sections from the Pila Spi carbonate revealed that the main matrix is micrite, with some microspar, and includes skeletal grains that belong to a shallow marine environment. While non-skeletal grains are poloids, intraclasts, and monocrystalline quartz, The formation was affected by several diagenetic processes, including micritization, dolomitization, physical compaction, solution, cementation, neomorphism, silicification, pyritization, iron oxidation, and fracturing. Five pore types were identified in the Pila Spi carbonate, and most of them are of secondary origin. They are fenestral and intraparticle porosities (primary) and moldic, vuggy, and fracture porosities (secondary). The solution and fracturing diagenesis enhanced porosity, particularly the secondary kinds in the carbonate rocks of the Pila Spi Formation. Whereas, early dolomitization aids in the formation of fenestral porosity. On the other hand, cementation, compaction, neomorphism, silicification, and pyritization reduced porosity in the studied formation. The karstic fissures and pores are the principal cause of the increasing aquifer characteristics of the Pila Spi Formation in the studied area, and iron oxidization has a negative effect on the water quality within the Pila Spi aquifer.

Keywords: Bjeel, Diagenesis, Eocene,Iraq, Pila Spi, Porosity.

GK6- 121

Sequence stratigraphy of two major incised valleys from the upper Cretaceous - Cenozoic successions within Kurdistan foreland basin, Iraq

Fadhil A. A. Lawa[1,*], Heshw A. Qadir[1] and Nagham Omar [2]

[1] Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Iraq

[2] Institute of Geosciences, University of Bonn, Germany

[*] Fadhil.ameen@univsul.edu.iq

Abstract

Two major incised valleys have been recorded from the Upper Cretaceous/ Cenozoic successions within the Kurdistan Foreland Basin. Iraq. The first incised valley is called Tanjero Conglomerate (about 250m thick) within the Maastrichtian successions of the Tanjero Formation, while the second one is nominated as Sarsul Conglomerate, which truncated the Upper Maastrichtian successions and terminated the Maastrichtian greenhouse and associated by Mass extinctions of all Maastrichtian fauna and flora. This study is based on an extensive field geological survey, as well as lithostratigraphic, biostratigraphic, and isotope Chemostratigraphic studies. Seven sections have been selected covering an area of about 800 km2 from the Chwarta– Mawat area within the Imbricated Zone (Western Zagros Fold-Thrust Belt) in the Sulaimanyah area, Kurdistan region. Iraq. As a result, those two major incised valleys represent a sequence boundary

of Type One, combined by major sea-level fall below the shelf break, and associated by intensive tectonic and volcanic activities. The Tanjero conglomerate is lensoidal in shape and composed of grain-supported, polymictic (Mainly ophiolites and chert fragments) massive conglomerates with very thin lenses of sandstone. The middle Maastrichtian conglomerate beds show angular boundaries with the underlying deep marine planktic-rich facies associations. They indicate a gap extending for about 1-2 ma between the Early and Late Maastrichtian successions emphasized by Foraminifera, calcareous Nanno fossils biozonations, and other macrofossils assemblages, as well as paleosols. The Sarsul incised valley is about 550m thick and consists of two major conglomerate units. They show a lensoidal shape and reduced towards the Iranian border to less than 100m (Nearby Bardbard- Isawa villages) truncated the Aqra rudist reef and or Tanjero Siliciclastic. Accordingly, a major gap and unconformity in the Maastrichtian/ Paleogene boundary is recorded. They are overlined by red siliciclastic freshwater deposits rich in charophytes representing the lowermost part of the Suwais Group (so-called Red Bed Series). This gap is also emphasized by carbon and Oxygen Isotopes results and the mass extinction of all Maastrichtian fauna and flora. They are combined by the extinctions of the Large Benthic Foraminifera, rudists as well as turnover from marine to non-marine sedimentary structures. The two Sequence boundaries indicate intensive tectonic and volcanism activities associated with a major sea-level fall at the middle Maastrichtian (Tanjero Conglomerate) and at the Late Maastrichtian/ Paleogene boundary (Sarsul Conglomerate).

Keywords: Sequence boundaries; Tanjero Conglomerate; Sarsul Conglomerate; Maastrichtian/Paleogene; Kurdistan Foreland Basin.

GK6- 122

Petrophysical Characteristics of the Shiranish Formation from the selected oilfields in the Kurdistan Region, NE Iraq

Danyar A. Salih* and Fouad M. Qader

Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Kurdistan Region, Iraq

* danyar.salih@univsul.edu.iq

Abstract

Petrophysical characteristics of the Shiranish Formation were analyzed at the Shewashan-2 (SH- and Bazian-1 (BZ-1) wells within the selected oilfields. The defined porosity of the studied formation suggested limestone and marly limestone. Moreover, at the SH-2 well the formation tends to have a lower shale content, which gradually increases downward in the well. Meanwhile, in the BZ-1 well, the middle of the studied formation consists mainly of shaly and shale intervals. In addition, it is observed that porosity values generally decrease deeper in the SH-2 wells, with most values being less than 7.0 %. However, there are a few intervals where porosity increases.

On the other hand, the BZ-1 well indicates a pattern of higher porosity at the top of the formation, gradually decreasing towards the bottom of the Shiranish Formation. It appears that the studied formation shows a higher porosity in the BZ-1 compared to the SH-2 well. Additionally, the secondary porosity at the top of the Shiranish Formation in the SH-2 well is measuring around to 5.0%. Nevertheless, in the BZ-1 well, it varies between less than 5.0% and 10%. Porosity along both SH-2 and BZ-1 wells is generally greater at the upper part of the Shiranish Formation. Rendering to the permeability, it seems that the formation has a poor to fair permeability in the well of SH-2, meanwhile it shows moderate to good permeability at the BZ-1 well. The Shiranish Formation can be divided into three reservoir units depending on the shale volume, porosity, and permeability. The RU-3 demonstrates the most significant reservoir characteristics in both of the studied wells. Nevertheless, the reservoir quality was found to be the lowest in RU-1 for the SH-2 and BZ-1 wells. Furthermore, a significant majority of the pore spaces in the formation is occupied by residual hydrocarbons.

Keywords: Shiranish Formation, Shewashan, Bazian, Porosity, Permeability, Reservoir Unit.

GK6- 123

Geoinformatics-Based Automated Landform Classification and Analysis of Their Relationship with Landslide Susceptibility in Akre District, Kurdistan Region, Iraq

Kaiwan K. Fatah* and Rebar T. Mzuri

Department of Earth Sciences and Petroleum, College of Science, Salahaddin University, Erbil, Kurdistan Region, Iraq

* kaiwan.fatah@su.edu.krd

Abstract

Landforms are fundamental components of landscapes and pivotal elements within the field of geomorphology. The comprehensive classification of landforms necessitates an advanced quantitative methodological approach capable of extracting discernible integral elements and patterns from Digital Elevation Models (DEMs). Identifying these patterns constitutes a crucial initial stage in recognizing and delineating landforms. The main objective of this research is to employ the Geomorphons technique at various scales, including neighborhood sizes of 5x5, 10x10, and 25x25 cells to autonomously categorize Geomorphon units (landforms) derived from 12.5-meter resolution ALOS PALSAR DEM within the SAGA-GIS software framework. Geomorphons serve as an effective model for characterizing the earth's morphology, encapsulating micro-landscape structures. Subsequently, the landform classes were correlated with landslide susceptibility zones through sophisticated spatial analysis functions in the designated area. The study area was classified into 10 distinct types of the most prevalent

Geomorphon units, including flat, valley, slope, foot slope, peak, pit, ridge, hollow, shoulder, and spur. The results indicated that the predominant landform type observed is closely associated with slopes, while the least prevalent is flat terrain. Landform patterns exhibit a strong correlation with natural hazards, particularly landslides. Notably, approximately 100% of the flat regions are situated within low and very low landslide susceptibility zones, while more than 45% of the summit, ridge, shoulder, spur, and slope areas are characterized by high to very high landslide risk zones. The insights gained from this study are valuable for categorizing zones susceptible to land degradation, landslides, and instability challenges. Understanding landforms serves as a critical parameter applicable to natural calamity assessment and future master planning in the Akre district of northern Iraq.

Keywords: Geomorphons, DEM, Geoinformatics, Landforms, Landslides susceptibility, and Akre District.

GK6- 124

Lateral variations in the reservoir properties of the middle Miocene Jeribe Formation in the Allas dome of the Hamrin oil field, northern Iraq

Dler H. Baban[1*] and Muhamad B. M. Saeed[2]

[1] Department of Earth Sciences and Petroleum, Sulaimani University, Sulaimaniyah, Kurdistan Region-Iraq

[2] Directorate of Oil and Mineral in Sulaimani, MNR, Kurdistan Region Government

[*] dler.mohamad@univsul.edu.iq

Abstract

The reservoir properties of the Jeribe Formation have been investigated from three wells in the southern dome of the Hamrin Oilfield (Allas Dome) based on conventional log data and cutting rock samples. The studied wells are arranged along the axis of the structure, which is in a southeast-northwest direction, with well Hr-50 being at the southeast part, followed by Hr-51 and Hr-49 towards the northwest. The Jeribe Formation's microfacies and wireline log analysis in the three wells of Hr-50, Hr-51, and Hr-49 at the Allas Dome of the Hamrin Oilfield led to the conclusion that both lithology variations and fluid content within the formation's pore spaces are responsible for the variations in the recorded data of the wireline logs in well Hr-50 toward the northwest locations of wells Hr-51 and Hr-49. The Jeribe Formation's lithology at well HR-50 is mainly dolostone, with more prevalent grainstone microfacies. As it moves toward the other two wells, it becomes predominantly limestone, with increasing contents of wackestone and packstone microfacies. The formation in well HR-50 has an average shale content of roughly 18.2% and an average porosity of about 18.8%. In well HR-51, the average shale content and porosity are nearly 16.21% and 12.37%, respectively, while in well HR-49, the average shale content is

about 18% and porosity about 12.73%. In well Hr-50, the distribution of the formation's shale is dispersed, laminated, and structural, whereas in the other two wells, dispersed shale distribution is nearly the only mode of distribution for the Jeribe Formation. The secondary porosity in the formation appears to be represented by separated voids, molds, and vugs, with well HR-50 exhibiting the largest percentage of secondary porosity (average 3.1%). The Jeribe Formation in wells Hr-51 and Hr-49 have predominantly gas reservoired hydrocarbons, while in well Hr-50 the formation is more likely to have oil reservoired hydrocarbons with a sizable immovable fraction. In wells Hr-51 and Hr-49, the reservoired hydrocarbon in the Jeribe Formation is primarily gas; in well Hr-50, however, the reservoired hydrocarbon in the formation is more likely to be oil, with a significant immovable portion. The three study wells' computed RQI and FZI values for the Jeribe Formation show that the formation has a tight reservoir rock type.

Keywords: Jeribe Formation, Hamrin Oilfield, Allas Dome, Reservoir properties, Log analysis.

GK6- 126

Reservoir characterization of Sarmord Formation from selected wells in Kirkuk and Khabbaz oil fields, Kirkuk, northern Iraq

Shabaz M. Ali[1,*], Danyar A. Salih[1], Sardar S. Fatah[1], Basim Al-Qayim[2] and Ibrahim M.Mohialdeen[1]

[1] Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Kurdistan, Iraq

[2] Department of Petroleum Engineering, Komar University of Science and Technology, Kurdistan, Iraq

[*]shabaz.mohammedali@univsul.edu.iq

Abstract

A study was carried out on the reservoir characteristics of the Sarmord Formation at the K-229 and KZ-14 wells in Kirkuk city, northeastern Iraq. GR log data was utilized to define the volume of shale content, indicating the studied formation typically has high shale content in the KZ-14 well, especially in the upper part of it, and the rest of the formation is mainly low shale intervals, whereas the uppermost part of the Sarmord Formation is dominated by higher shale volume and downward indicating shaly and shale zones at the K-229 well. The porosity estimates were derived from the sonic, density, and neutron logs data, revealing that the values tend to be consistently below 10% and 15% in wells of K-229 and KZ-14, respectively. However, in both wells, there are a few intervals where porosity significantly increases at the upper part of the studied formation. The formation's measured permeability suggests good permeability in RU-1 and 2 at the KZ-14 and K-229 respectively. Based on the determined porosity, permeability, and volume of the shale content, the formation is subdivided into three reservoir units at the well of K-229 and two reservoir units in the KZ-14 well. Among the distinguished units, RU-1 in the K-229 studied well, and RU-2 at the well of KZ-14 was regarded as possessing the least reservoir quality

properties, as the porosity and permeability indicate lower values, as well as their shale volume, being the greatest. Conversely, the most substantial reservoir appeared within RU-1 in the KZ-14 well and RU-2 in the well of K-229. A variety of fractions within the pore spaces detect residual hydrocarbons, while some horizons of RU-1 and 2 at the KZ-14 and K-229 wells reveal tiny portions of the moveable ones. The K-229 well documented a higher proportion of water saturation compared to the KZ-14 well. Additionally, the identified reservoir units along both of the studied wells cannot be productive zones. The fluid flow of the Sarmord Formation is primarily influenced by fracture flow and matrix flow in the reservoir units of the studied wells.

Keywords: Sarmord Formation, Khabbaz Oilfield, Kirkuk oil field.

GK6- 128

Geometric analysis of the Khwelen anticline from the Western Zagros Fold Thrust Belt in Kurdistan Region, NE Iraq

Adil O. Abdulla [1*], Salim H. S. Al-Hakari[2] and Fadhil A. A. Lawa[2]

[1] Department of Applied Geology, College of Science, University of Kirkuk, Kirkuk, Iraq

[2] Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Sulaimani, Iraq

*adilabdalla@uofkirkuk.edu.iq

Abstract

Khwelen Anticline is one of three en echelon anticlines (Ashdagh, Qarawais, and Khwelen) within the low Folded-Thrust Zone, part of the NW segment of the Zagros Fold-Thrust Belt in the Garmian district of the Iraqi Kurdistan Region. The anticline is very close to the high-folded thrust zone-low-folded thrust zone boundary. It is on the same trend as the Chamchamal anticline. The exposed rocks unit in the anticline range in age from the early Oligocene to the late Miocene, represented by the five Formations. The Kirkuk group and Jeribe Formation cropped out (in deep valleys) at the eroded core of the anticline. The Fatha Formation, as a carapace, formed the main geometric body shape of the anticline. While the Injana Formation is located at the two neighboring synclines. The field observation along the three traverses normally to the structure with the aid of remote sensing data; addition to the geometrical analysis of the anticline shows that the Khwelen anticline is an asymmetrical, single plunged, ~10 km length and 5 km width, open box fold, with NW-SE trend. Its SW limb is steeper and more deformed than the NE limb. The anticline, at its maximum wavelength, is cut by an oblique strike-slip fault (Transverse fault). This fault separates the Khwelen anticline from the Qarawais anticline at SE. This study reveals that the anticline is a Fault propagation fold developed above the thrust fault starting from the detachment level located at the base of the Jurassic series or in the Triassic.

Keywords: Khwelen anticline, fold analysis, Kirkuk Group, Garmian district, Zagros Fold-Thrust Belt.

GK6- 130

Groundwater Potential Mapping Using Geospatial Approaches Combined with Electrical Resistivity Tomography in Bazian Basin, Sulaymaniyah City, Iraqi Kurdistan Region

Hawber A. Karim*, Zana Rughzai, Azad Sangawi and Bakhtiar Q. Aziz

Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Sulaimani, Iraq

*Hawber.karim@univsul.edu.iq

Abstract

In the Bazin basin, groundwater plays a crucial role in agriculture and other activities. Unfortunately, excessive legal and illegal well extraction over the past three decades has led to a significant decline in the water table. To address this challenge, the study combined geographic information system (GIS) data with Electrical Resistivity Tomography (ERT). The objective is to create a geospatial model for groundwater potential using multi-criteria analysis techniques, supported by geophysical approaches. This study used seven thematic layers, including geology, rainfall, slope, lineament density, drainage density, land use/land cover, and runoff, and finally combined them with remote sensing data, Google Earth Engine, and conventional information within the GIS environment. Thematic layers were ranked based on their importance for groundwater potential and weighted using the MCDA-AHP analysis. Meanwhile two-dimensional (2D) electrical resistivity tomography was conducted using the SYSCAL R1 PLUS along three profile lines distributed over study area. The data were recorded using the Wenner–Schlumberger array, and the raw data was subsequently processed using the Res2dinv software. The resulting groundwater potential zones for total area (362) km^2 (GWPZs) were categorized into five zones: very low, low, moderate, high and very high. The covered percentages of area for each level were 4.4%, 8.9%, 34.3%, 32.7, and 19.7%, respectively. Electrical resistivity tomography (ERT) and well extraction rates are used to validate groundwater potential zones (GWPZs). The results from three ERT profiles align with the potential zones map. Additionally, a second validation using extraction rates from 40 wells confirmed these findings.

Keywords: ERT, AHP, GIS, GWPZs, Bazian.

GK6- 132

Statistics Analysis for the hydrochemical parameters of Euphrates River between Musayab and Al-Hindya, Middle part of Iraq

Alyaa SH. Oleiwi[1, *], Qusai Y. Al-Kubaisi[2] and Alhassan H. Ismail[3]

[1] Department of Water Resources, College of engineering, University of Baghdad, Jadiriya, Iraq

[2] Department of Geology, College of Science, University of Baghdad, Iraq

[3] Water Resources Techniques Department, Institute of Technology-Baghdad, Middle Technical University, Baghdad, Iraq

[*]Alia.s@coeng.uobaghdad.edu.iq

Abstract

The Euphrates River is an important river in Iraq. In the recent years, the effecting of climate changes on the decreasing discharge rate and water quality of the Euphrates River. The purpose of this research is to evaluate the physicochemical parameters for the water of the Euphrates River through the period (2021-2022) by using Principal Component Analysis (PCA) and applying the Water quality index (WQI) with different methods, in addition to analyses their suitability for irrigation purposes by applying the following parameters which are (Sodium Adsorption Ratio (SAR), percentage of Na+%, Residual Sodium Bicarbonate (RSBC), Magnesium Hazards (MH), and Kelly's ratio (KR)). The results of WQI shows that water classified as poor to very poor for drinking purposes in all sites. The water classified as Excellent, Good, Safe/Good, and suitable water quality for irrigation purposes. The PCA extractions five factors that effects on the water quality of the study area may due to a chemical weathering of water&rock interaction that is widespread in the Euphrates River Basin that contents of Quaternary deposits, carbonate rocks and limestone rocks, in other hand, (nitrate and phosphate) are dominant factors, that effects on the water quality may due to which are generally contributed by fertilizers (both from agricultural and industrial), indicating anthropogenic influences. Finally, the high values of TDS this attributed to the effect of decreasing the discharge rate, in addition to the effect of climate conditions as temperature and evaporation and decrease the rainfall rates, in addition to anthropogenic processes.

Keywords: TDS, PCA, WQI, Euphrates River.

GK6- 133

Paleontology and geochemistry of river's sediments from central Iraq

Fouad S. Al-Kaabi* **and Raghad A. Hussain**

The Central Laboratories, Geological Survey, Iraq

*fouadsaleem77@yahoo.com

Abstract

Tigris and Sirwan rivers are crossing different type of formations and can load different sediments and microfossils. Although chemical of sediments can show change in environment, microfossils may be also representing the record of environment. Therefore, this study aimed to use chemical and microfossils data to test their ability to discriminate these sediments. Thirty-two samples found to be contained different types of microfauna such as pelecypoda, gastropoda, cephalopoda, ostracoda and forinmifera. The results showed that pelecypoda, gastropoda and cephalopoda were distributed in Tigris River in Baghdad city which prefers freshwater environment, and very few number of Miocene forinmifera which transported by weathering old formations in upstream. While, Sirwan River was enriched by ostracods, and reflected clam environment. The study also reflected that some major and trace elements in rivers' sediments appear to be important factor that governed distribution and assemblage some species. The chemical results also illustrated that decreasing SiO2 and increasing Al2O3, Fe2O3, TiO2, SO3, Cr, Cu and Mn toward downstream in Tigris River caused decreasing pelecypoda, gastropoda and cephalopoda. While, CaO, LOI, SO3, P2O5, Cu, Pb, Sr and Zn were two times in Sirwan River's sediments.

Keywords: Sediments, River, Environment, Discrimination, Freshwater microfossils.

GK6- 133

Risk intensity mapping of complex aquifer systems using the phosphate-drastic model: insights from the Penjween Basin, NE Iraq

Rebar A. Qaradaghy*, [1], Dara F. Hamamin[2] and Diary A. Al-Manmi[3]

[1] Groundwater Directorate of Sulaymaniyah, Iraq

[2] Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Iraq

[3] Department of Petroleum and Energy Engineering, Technical College of Engineering, Sulaimani Polytechnic University, Sulaymaniyah, Iraq

* rebar.qadir@univsul.edu.iq

Abstract

Identifying human-caused groundwater contamination is crucial for sustainable management, especially in semi-arid climates like the Penjween basin. Effective management requires comprehensive risk assessments, including hazard and vulnerability mapping. Adhering to the European COST Action 620 guidelines, this study evaluated groundwater contamination risks by integrating hazard and vulnerability maps using the PO_4^{-3}-DRASTIC models: the assessment employed together with standard and pesticide DRASTIC index maps based on seven parameters. The standard DRASTIC index classified pollution vulnerability into four categories: Very Low, Low, Moderate, and High. The results indicated that Very Low and Low vulnerability classes covered 23.2% (210 km²) and 47.7% (431 km²) of the area, respectively. The pesticide DRASTIC index, ranging from 88 to 207, identified five vulnerability classes: Very Low, Low, Moderate, High, and Very High, with most areas falling under Moderate (39.9%) and High (33.9%) vulnerability classes. The highest-risk areas were located in two key regions: the southwestern part, including Braim Awa Plain and Penjween Town, and the stream banks. These regions have intergranular aquifers, extensive vegetable cultivation, and urban development. The latter makes them more susceptible to contamination from agricultural and municipal sources due to high rating values of causative parameters such as net recharge, aquifer media, topography, and hydraulic conductivity. Consequently, restrictions on agricultural activities, particularly the use of high rates of agrochemicals, are recommended. Phosphate concentration in 40 groundwater sources ranged from 0.01 to 4.86 mg/l, with over 67% exceeding the Iraqi guideline of 0.4 mg/l. The majority of the high concentration of phosphate is located in regions of moderate to high vulnerability, confirming the reliability of the DRASTIC maps. The risk intensity map revealed that most of the basin falls within very low or low-risk zones for contamination, highlighting the need for targeted management strategies to safeguard groundwater quality and ensure sustainable management practices.

Keywords: Groundwater contamination; Risk assessment; Standard and Pesticide vulnerability; Semi-arid climate.

GK6- 136

Deciphering geospatial modeling of groundwater potential zones using integration of geostatistical and geophysical approaches in Sulaimani basin, NE of Iraq

Sarkhel H. Mohammed[1,2,4,*], Hawber A. Karim[2], Diary A. M. AL-Manmi[3], Bakhtiar Q. Aziz[2], Asaad I. Mustafa[2] and Péter Szűcs[1,4]

[1] Institute of Water Resources and Environmental Management, University of Miskolc, Hungary

[2] Department of Earth Sciences and Petroleum, College of Science, University of Sulaimani, Iraq

[3] Technical College of Engineering, Sulaimani Polytechnic University, Iraq

[4] National Laboratory for Water Science and Water Security, University of Miskolc, Institute of Water Resources and Environmental Management, Miskolc

[*]sarkhel.geo@gmail.com

Abstract

Groundwater is a vital source of water for all human activity in the world, and it is even more crucial for the development of countries. The dramatic decline in groundwater resources necessitates modern groundwater management techniques. Th us, due to the behavior of groundwater (GW) dynamics, evaluating potential areas of GW is still ambiguous. This study implements a GIS-based, remote sensing, and multi-criteria analytical hierarchy process (MCDA-AHP) approach to identify favorable groundwater zones supported by hydrogeological data in the Sulaymaniyah basin (SB). Furthermore, electrical resistivity tomography (ERT) was used to support the multi-parameter selection and verification of the groundwater potential zones (GWPZs) model. Six thematic maps were created from various sources like geology, existing well data, satellite data, and conventional maps to derive the input layers of rainfall, geology, lineament density, slope, drainage density, and LU/LC. The input thematic maps were ranked based on their comparative contribution to controlling groundwater availability. Additionally, integrated hydrogeological data, Receiver Operating characteristics (ROC) curve, and Area Under the Curve (AUC) approach were used to verify geospatial GWPZs. The promising result shows a close agreement between GWPZs and the verified results. The groundwater potential mapping was produced using a GIS weighted sum function that accounted for each layer's influence on groundwater possibility. Lastly, three potential zones were identified: the low, moderate, and high potential zones, which covered 11.26%, 45.51%, and 43.23% of the area, respectively. The findings can provide invaluable, robust insight to minimize the hydro-geophysical investigation and dried borehole number for successful sustainable groundwater resource management in SB.

Keywords: Electrical resistivity tomography (ERT), Multi-criteria assessment, Sulaymaniyah, Water resources management.

GK6- 137

The relation of recorded velocity behavior with geological formations thickness in Iraq

Salar S. H. Al Karadaghi

Geology and Geophysics Department, Iraq Oil Exploration Company, Baghdad- Iraq

zaidko.82@gmail.com

Abstract

The mechanism of the velocity analyses from the available data of the Iraqi oil wells velocity surveys and its comparison with geological formations thicknesses within the sedimentary basins, showed good correspondence within the depositional basin of the Mesopotamia region in the mid of Cretaceous period Formations. Beside that within the sedimentary basin of Al-Rutba region of the Western Desert in the Paleozoic era. as well the comparison with the Bouguer gravity map, which depends mainly on the lithological densities differences along with sedimentary formations, showed completely corresponded with a depositional basin of the Mesopotamia region in the mid of Cretaceous period Formations. The aim of this comparison is to prove that the relationship of the depositional thickness and their distribution with Lateral variability behaviors in the sedimentary basin areas across Cretaceous and Tertiary formations is true, on the other hand, the seismic stack-velocity and their application to the selected areas within the Nineveh patch, showed implicitly the faults systems and regionally the structural shape. This research recommends the use of optimal output of the seismic velocity within the picked reflectors because it can give a sedimentary and compositional visualization of the areas where drilling data are not available or where well velocity survey data are not available, especially in the western desert regions of Iraq.

Keywords: Check-shot, Bouguer, behaviours, stack-velocity, Nineveh.

GK6- 138

Middle Oligocene-Early Miocene Red beds in the High Folded Zone of Kurdistan, Iraq

Soran O. A. Kharajiany

University of Sulaimani, Kurdistan Regional Government, Iraq

soran.muhammad@univsul.edu.iq

Abstract

The sedimentary successions of the Oligocene in Iraq and Kurdistan Region are well-known as the Kirkuk Group Formations. They represent the prominent reservoir rocks for hydrocarbon accumulation that comprise three-reefal sedimentary cycles; the lower, middle and upper cycles. In the Low Folded Zone the middle and upper Oligocene cycles are represented by limestone, but in the High Folded Zone the middle Oligocene is limestone beds while the upper Oligocene is consisted of a red claystone bed. This red bed was noticed and determined as a result of multiple field trips and stratigraphic study in the High Folded Zone. Hence, for the first time, this red bed is documented, introduced, interpreted and determined as a red claystone that belongs to the upper Oligocene/Chattian epoch. It is equivalent to the Anah Formation of the Low Folded Zone of Iraq. This new-introduced red bed is here attributed to the continental facies/levee of the late Oligocene-reefal faciescof the Low Folded Zone. The Oligocene basin elevated due to tectonic process and the sea level drawn down, as a result shallowing happened and the red bed originated. For the first time the continental facies/levee sediments of the Oligocene basin is categorized.

Keywords: Oligocene, Kirkuk group, Kurdistan region- Iraq.

Geological Field trip

The field trip will take place in the Chwarta-Mawat area , Sulaimani governorate, Kurdistan, Iraq, on the 7th November 2024.

پوختەی توێژینەوەکان

جیۆکوردستان ٦

شەشەمین کۆنفرانسی نێودەوڵەتی جیۆلۆجی کوردستان

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