



Field Description and Lithostratigraphic Study of Sargelu Formation in Rania and Sargelu sections, Northern Iraq

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Abstract

The Sargelu Formation was deposited during the Middle Jurassic, representing one of the most important source rocks in Iraq and surrounding areas.

Jurassic successions are commonly exposed as an isolated patch at some eroded anticline's cores and limbs in the High Folded Zone, Imbricate Zone, and Thrust Zones of northern Iraq. The Sargelu section is located in Sargelu village at Surdash anticline, while the Rania section is located in Rania city near Hanjira village at Showeri anticline. Fieldwork in Rania and Sargelu Sections allow to divide Sargelu Formation lithostratigraphically into many subdivisions as follow:

The Sargelu Formation in the Rania section is about 40 m and can be divided into two lithologic units; the upper thin to medium bituminous limestone beds alternated with thin chert beds, and the lower thin to medium bituminous limestone beds alternated with fissile gray shale beds.

The Sargelu section comprises 180m and is divided into three units; the upper unit consists of dark gray limestone beds and thin brownish-black of laminated shale. The middle unit includes dark chert alternated with dark gray bituminous limestone and brownish-black laminated shale. At the same time, the lower unit consists of dark gray bituminous limestone beds alternated with medium brownish-black laminated shale beds.

Keywords: Field Description, Lithostratigraphy, Sargelu Formation, Rania Section, Sargelu Section.

الوصف الحقلّي ودراسة الطباقية الصخرية لتكوين ساركلو في مقطعي رانيا و ساركلو ، شمال العراق

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الخلاصة

ترسب تكوين ساركلو خلال العصر الجوراسي الأوسط، حيث يمثل أحد أهم الصخور المصدرية في العراق والمناطق المحيطة به.

تتكشف تتابعات الجوراسي بشكل شائع بشكل منكشفات متفرقة في بعض مراكز وأطراف الطبقات المحدبة المتأكلة في نطاق الطبقات العالية والنطاق المتراكب ونطاق الفوالق الزاحفة في شمال العراق. يقع مقطع ساركلو

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في قرية ساركلو ضمن طية سورداش المحدبة، بينما يقع مقطع رانيا في مدينة رانيا بالقرب من قرية هنجيرة ضمن طية شاويري المحدبة.

تمت الدراسة الطباقية الصخرية لتكوين ساركلو من خلال العمل الميداني وتصنيف الوحدات الصخرية في مقطعي رانيا وساركلو ، حيث اظهرت الملاحظات الحقلية الميدانية العديد من الوحدات الصخرية الثانوية على النحو الآتي: -

يتميز تكوين ساركلو في مقطع رانيا بسماك حوالي 40 مترًا ، حيث ينقسم إلى وحدتين صخريتين ، الأولى تتكون من طبقات الحجر الجيري الرقيقة إلى المتوسطة الحاوية على القير والتي تتناوب مع طبقات رقيقة من الصوان. هذه الوحدة مقسمة إلى وحدتين فرعيتين ، العلوية تتكون من الحجر الجيري الحاوي على القير والذي تشبع فيه ترقرقات من الصوان. بينما تُظهر الوحدة الفرعية السفلية تطبيقات صخرية من الصوان تتخللها طبقات من الحجر الجيري.

وتتكون الوحدة الثانية من طبقات رقيقة إلى متوسطة من الحجر الجيري الحاوية على القير والتي تتعاقب مع طبقات من الصخر السجيلي الرمادي المترقق.

في حين اظهر مقطع ساركلو 180 مترًا من تكوين ساركلو الذي ينقسم إلى ثلاث وحدات صخرية. تتكون الوحدة العلوية من طبقات من الحجر الجيري الرمادي الداكن مع ترقرقات من الصخر السجيلي البني الداكن. في حين تتكون الوحدة الوسطى من ترقرقات الصوان الداكن المتناوبة مع الحجر الجيري القيري الرمادي الداكن إضافة الى الصخر السجيلي المترقق البني الداكن. بينما تتكون الوحدة السفلى من طبقات الحجر الجيري القيري ذات اللون الرمادي الداكن المتناوبة مع ترقرقات السجيل ذات لون البني الداكن.

1. Introduction

The Sargule Formation (Middle Jurassic) represents one of the most important source rocks in Iraq and surrounding areas. It cropped out with other Jurassic formations in northwestern and northern Iraq as small scattered patches within a narrow belt that trending from (Halabja) in the SE to (Duhok) in the NW such as; Halabja, Hanjira village northwest Rania town, Gara mountain in Gali-Zewki south of Amadia, Naokelekan village near Rownduz and Banik village northeast of Zakho. Wetzel [1] described the lithology of the Sargelu Formation in the Surdash anticline. The type section is 115m composed of thin-bedded black bituminous limestone, dolomitic limestone and black papery shales with streaks of thin black chert bands. The Sargelu Formation was deposited euxinic marine environment, with some inlayers showing shallowing or aerated conditions [2]. The shallower and better-aerated environment occurred mainly in the stable area [2]. This study concentrates on two of the outcrops, namely; Sargelu and Rania sections; it represents an attempt to exploit the information gathered from field description and petrology in deciphering the lithostratigraphy classify and distribution for the studied succession.

The studied area covers two outcrops. They are located within the Sulaimaniya governorate in northeastern Iraq. The first section is bounded by latitude (35°52'2.0") North, and longitude (45°09' 49.0") East near Surdash village 180 m thick while the second section with a thickness of 40 m lies within latitude (36°17'11.8") North, and longitude (44°51' 17.2") East near Hanjira village 2km northwest of Rania town (Figure 1).

The studied area covers two Sargelu Formation outcrops. They are located within the Sulaimaniya governorate in northeastern Iraq. The first section is bounded by latitude (35°52'2.0") North, and longitude (45°09' 49.0") East near Surdash village 180 m thick while the second with a thickness of 40 m lies within latitude (36°17'11.8") North, and longitude (44°51' 17.2") East near Hanjira village two km north-west of Rania town (Figure 1).

This study aims to summarise the field observation and lithostratigraphic study of the Sargelu Formation in Rania and Sargelu sections.

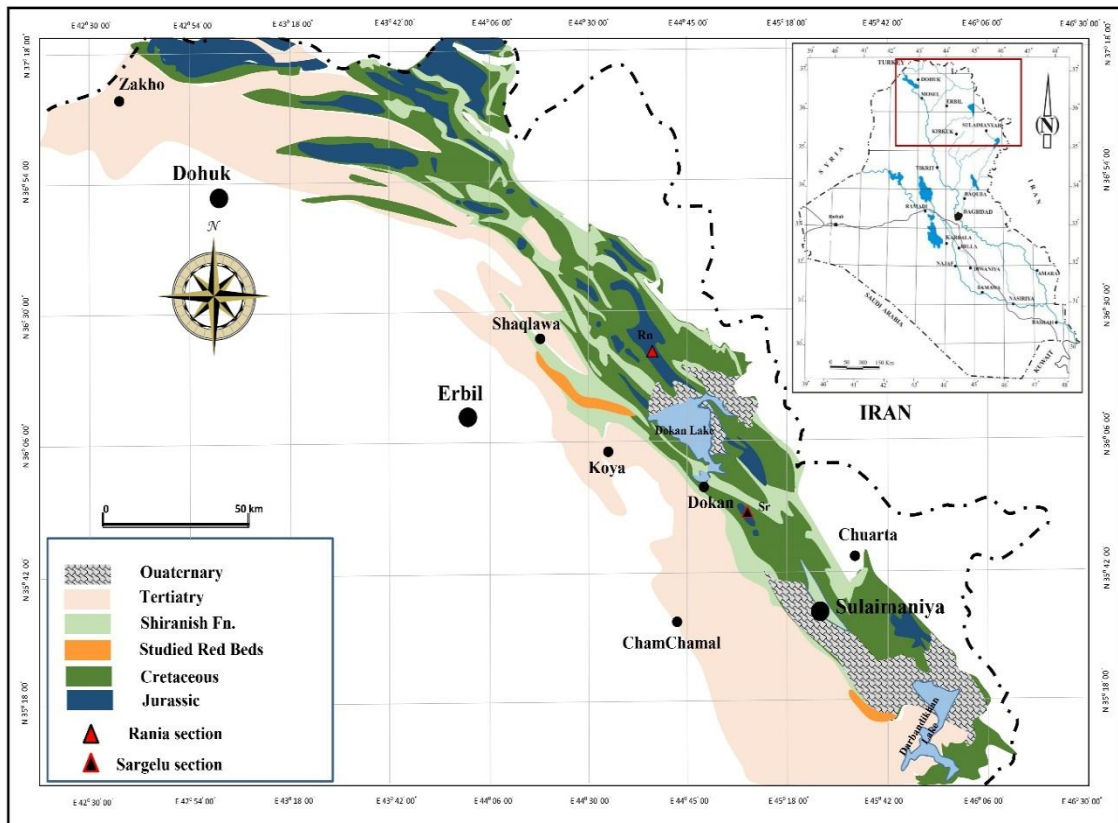


Figure 1- A geologic map showing the location of the two studied sections, according to [3] modified after [4].

2. Methodology

Fieldwork covered two sections of the Sargelu Formation, and it involved both description and sample collection from Rania and Sargelu sections. Forty-two (42) samples were collected from the Sargelu section and 38 from the Rania section to cover the major lithologies: limestone, chert, shale, the si and dolomitic limestone in a line perpendicular to the strike of the exposed beds. The distribution and number of samples for each site depend primarily on the availability of the outcrops.

3. Geological setting

The distribution of the Sargelu Formation in the northeastern part of Iraq is shown in Figure 1, whereas the lower contact with the Sehkanian Formation and the upper contact with the Naokelekan Formation and correlation with other age-correlated formations are illustrated in Figure 2.

Geologic Time Unite				Iraqi Territory			
Era	Period	Epoch	Age	Western	Central	North & Northeastern	
Mesozoic	Jurassic	Late	Tithonian	Makhul	Karimia	Chia Gara	
			Kimmeridgian (Middle-Late)		Gotnia	Barsarin	
			Kimmeridgian (Early)		Najmah	Naokelekan	
			Oxfordian				
		Middle	Callovian				
			Bathonian				
			Bajocian	Muhaiwir	Sargelu		
			Aalenian				
			Toarcian		Alan		
		Early	Pliensbachian		Mus		Sehkanian
			Sinemurian		Adaiyah		
			Hettangian		Butmah		Sarki
			Rhaetian		Baluti		
			Triassic	Late			

Figure 2- Correlation chart of Jurassic succession in Iraq, modified after [5].

The contact between Sargelu and Naokelekan formation is sharp and conformable and characterized by black thin-bedded, highly bituminous shales with thin bands of black chert at the top of Sargelu Formation, abruptly followed by well bedded grey limestone rich in stromatolites of the Naokelekan Formation [6]. This succession contains abundant oil-prone organic matter. The generation and expulsion of the hydrocarbon from the Sargelu Formation began and ended in the late Miocene succession [5].

3.1 Sehkanian Formation

This formation was described as a first time by Wetzel (1959) according to Bellen et al. [1] in the Surdash anticline within the High Folded Zone of Northeast of Iraq. The tectonic subsidence is high to moderate at Upper Jurassic to Lower Cretaceous. At the same time, slow subsidence with distinctive uplift was existed in Miocene [7]. The formation, in the type locality, was divided into three divisions. The thickness in the lower division is 85 m, and it is composed of dark saccharoidal dolomites and dolomitized limestones with some solution breccia. In the middle, the thickness is 44 m and is composed of organic and pelletal fossiliferous limestones usually, there is dolomitization with some dark chert beds (Figure 3). The thickness of the upper division is 51 m is composed of dark, violet, saccharoidal dolomites and dolomitic limestone, locally with chert [1]. The formation was deposited under neritic conditions showing lagoonal evaporitic influences mainly in the lower part and euxinic marks in the middle part [8]. Based on the evidence of fossils, the Liassic age for the Sehkanian Formation had been accepted [1]. The formation contacts are both clearly conformable and gradational, with underlying Sarki Formation and overlying Sargelu Formation [2].

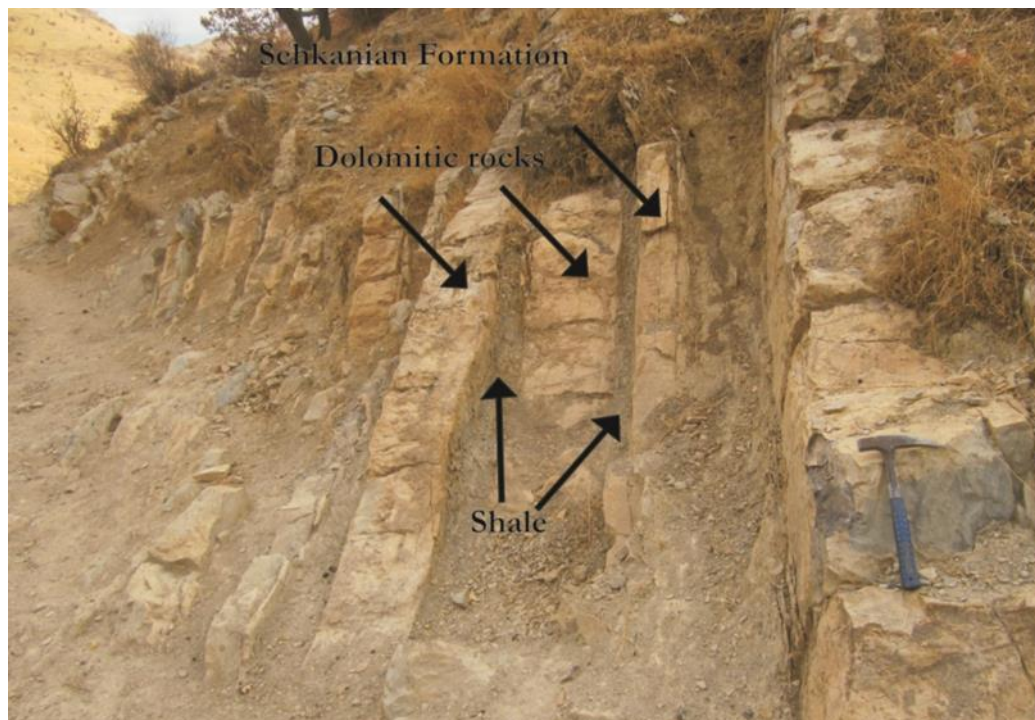


Figure 3-Sehkanian Formation in Rania section.

3.2 Sargelu Formation

The Sargelu Formation was described as the first time by Wetzel in 1984 according to (Bellen et al. [1]) at the Surdash anticline of the High Folded Zone in Northeastern Iraq. The lithology of this succession consists of thinly bedded, black bituminous limestones, dolomitic limestone, and black laminated shales with thin bands of black chert in the upper part [1].

The same lithological composition occurs along the whole area of outcrops and the wells [2]. The thickness of this succession in the type locality is 115 m. In contrast, in the subsurface section on the Foothill and Mesopotamian zone of Unstable shelf, the thickness is considerably higher and varies between 250-500 m, such as described by Ditmar et al. [9].

According to the evidence of fossils, the age of the formation has been determined as uppermost liassic at the base and Bathonian at the top [1]. The formation environment is euxinic, with some inlayers showing either shallowing of better aerated conditions. The shallower and better aerated environment occurred mainly on the stable shelf area [2]. The contacts of the Sargelu Formation are conformable and gradational with the underlying Sehkanian Formation and overlying Naokelekan Formation (Figure 4).

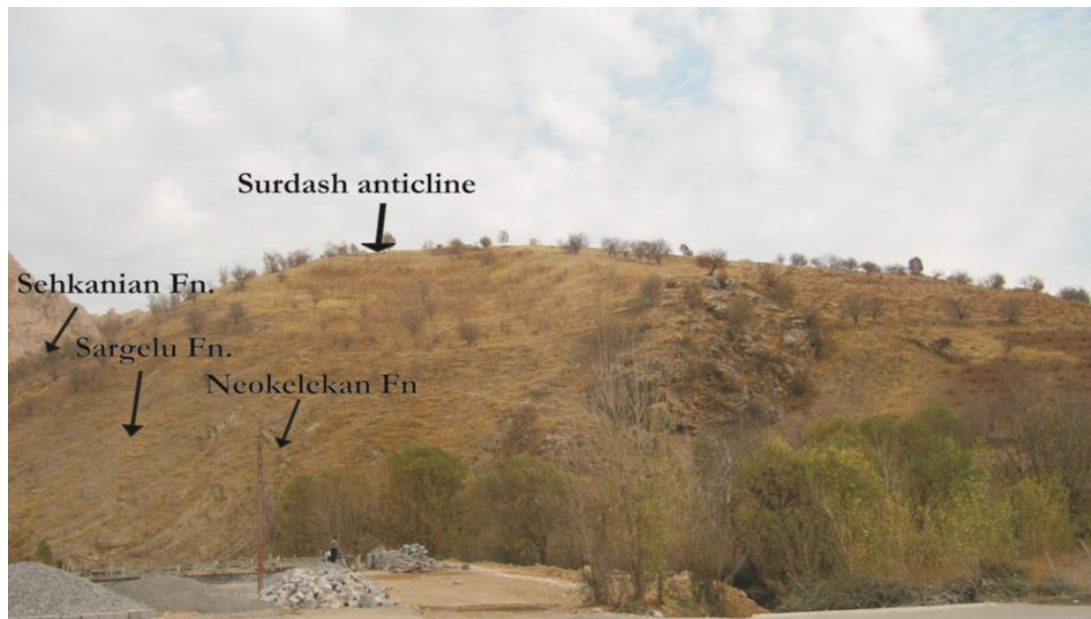


Figure 4-Sargelu Formation in Surdash anticline, Rania section.

3.3 Neokelekan Formation

Wetzel and Morton (1950) were described this formation near Naokelekan village, Northeastern Iraq [1]. The succession of the formation was described by [2] from top to bottom:

- Laminated bituminous shaly limestones bed alternation with bituminous shales beds and fine-grained limestones beds.
- Fine-grained mostly hard thin bedded, fossiliferous dolomitic limestones beds.
- Thin bedded, highly bituminous dolomites and limestones with intercalated black bituminous shale beds.

Jassim and Buday [9] also interpreted the depositional environment as euxinic, and the formation was deposited in a slow subsiding basin. Bellen *et al.* [1] determined the age of the Naokelekan Formation at Late Oxfordian – early Kimmeridgian. Many researchers agree the contacts of this formation to be conformable and gradational with underlying Sargelu Formation and overlying Barsarin Formation [10] (Figure 5).



Figure 5-Naokelekan Formation in Rania section.

Buday [2] divided Iraq into several tectonic zones, and Al- Kadhimi and others [11] simplified the Iraq tectonic zone and modified and updated by Fouad, 2014.

Jurassic succession is commonly exposed as isolated patches at some eroded anticlines cores and limbs within the High Folded Zone, Imbricate Zone, and Thrusting Zones in the north of Iraq according to Fouad tectonic classification at 2014 (Figure 6). The sections are as follow:

- 1- Sargelu Section: this is the name of Sargelu village located within Unstable Shelf, High Folded Zone, including Surdash anticline.
- 2- Rania Section: this is the name of Rania city near Hanjira village that is located within Unstable Shelf, Imbricate Zone, including Showeri anticline.

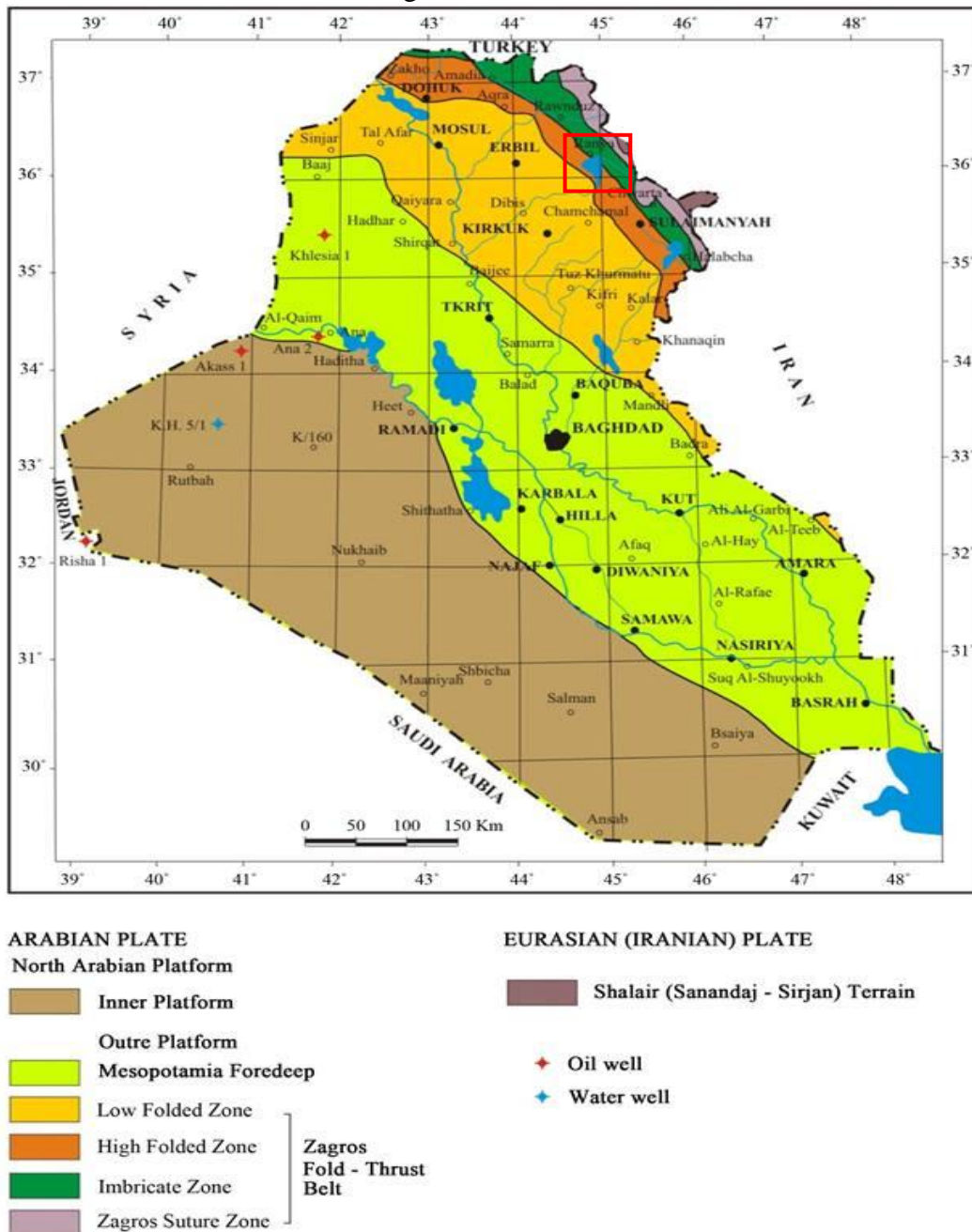


Figure 6- Tectonic map of Iraq showing the tectonic of the studied area [12].

4. Lithostratigraphy

Two main sections are described as a lithostratigraphic columns in this study; these are Rania (Rn) and Sargelu (Sr) sections.

4.1 Rania Section (Rn):

This section is located at latitude ($36^{\circ} 17' 11.8''$ N) and longitude ($44^{\circ} 51' 17.2''$ E). Its elevation is (880 m) with a total thickness of (40 m). It is exposed in the Shaweri anticline (Figure 7) and about 96 km to the north of Sulaimaniya city. Samples were selected from this section mostly of limestone, chert and shale (Figure 8A, B). The dip amounts up to 40° and the strike was N40W. Figure 9 shows the Rania columnar section with field description.



Figure 7- Rania Section in Shaweri anticline

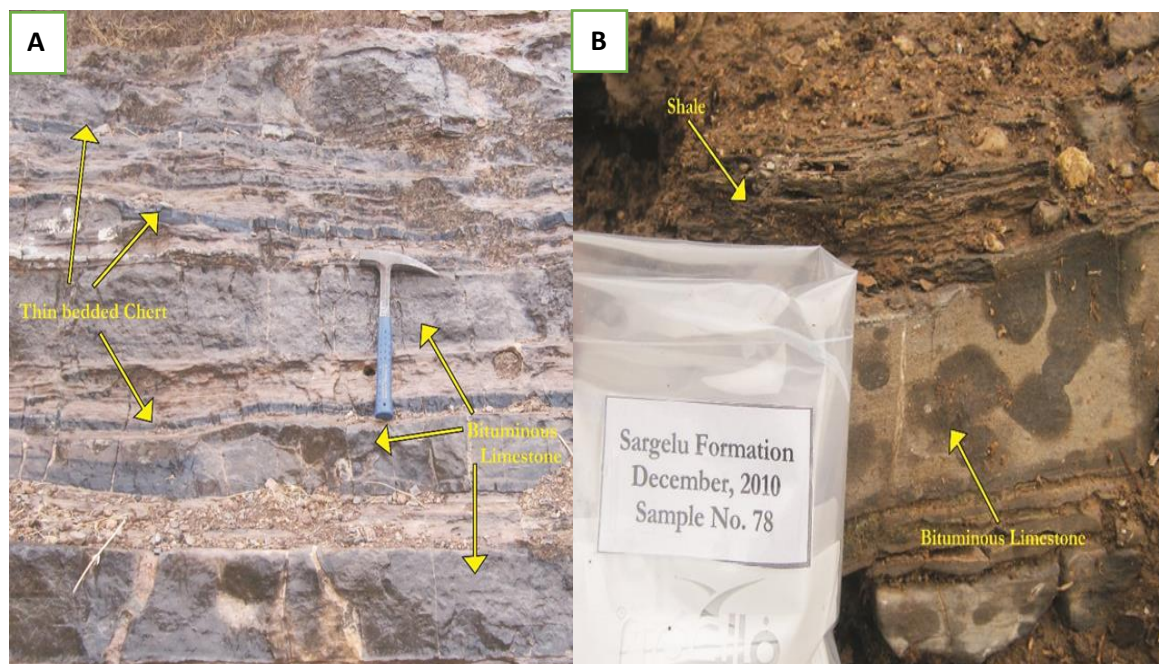


Figure 8- A. Chert beds of the Sargelu Formation B. Shale beds of the Sargelu Formation

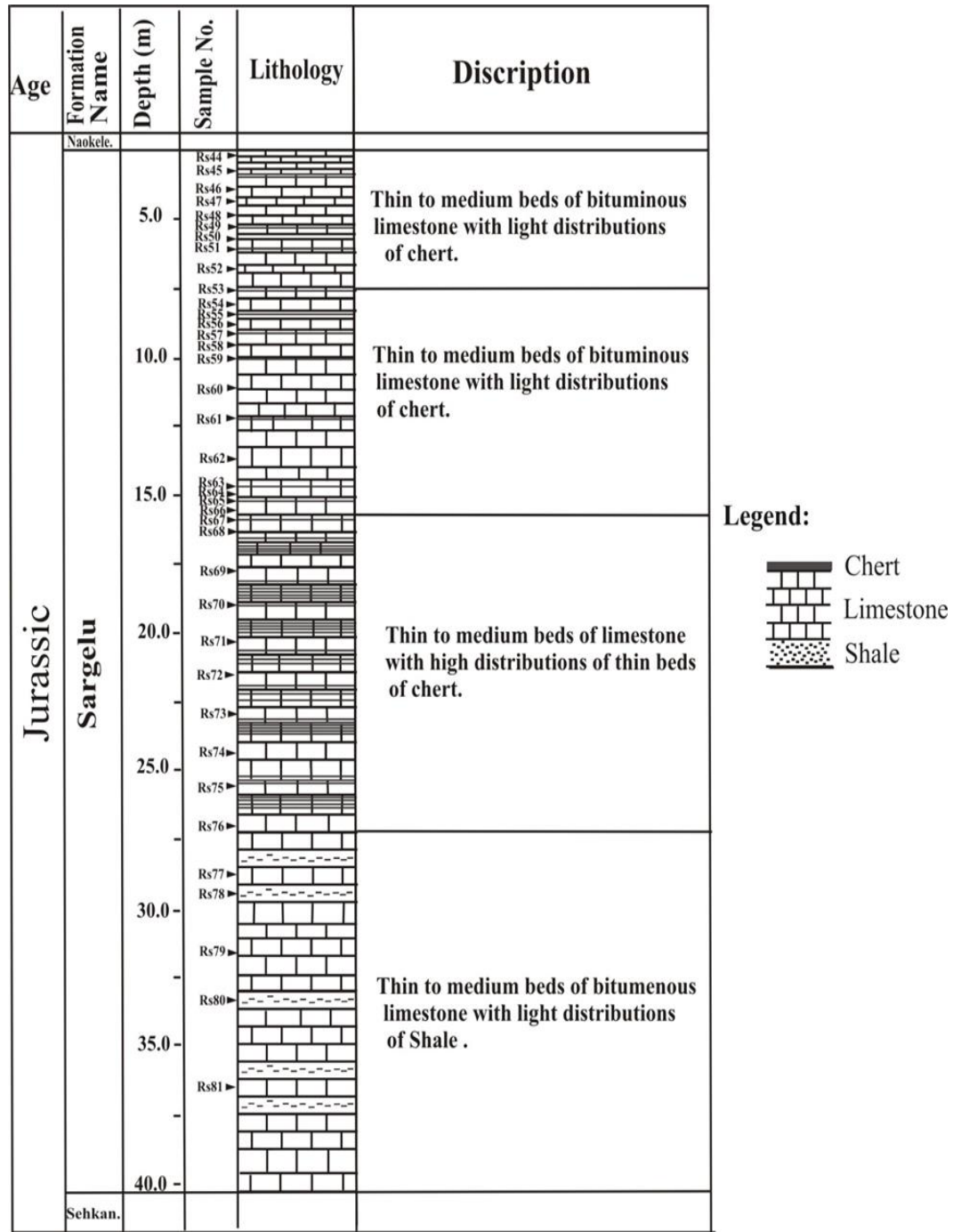


Figure 9-Stratigraphic column of Sargelu Formation, Rania Section.

4.2 Sargelu Section (Sr):

This section is located at latitude (35° 52' 2.0" N) and longitude (45°09'49.0" E). Its elevation is (1028 m) with a total thickness of (180 m). It is exposed in the Surdash anticline and about 42 km to the north of Sulaimaniya city. Samples were selected from this section mostly of limestone, chert and shale (Figure 10). The dip amounts up to (78°) and the strike was N60W. the Sargelu Formation in this section is divided in to three units according to field observations (Figure 11 A, B and C). Figure 12 shows the detailed description of the Sargelu section.



Figure 10-Shale beds in Sargelu Section

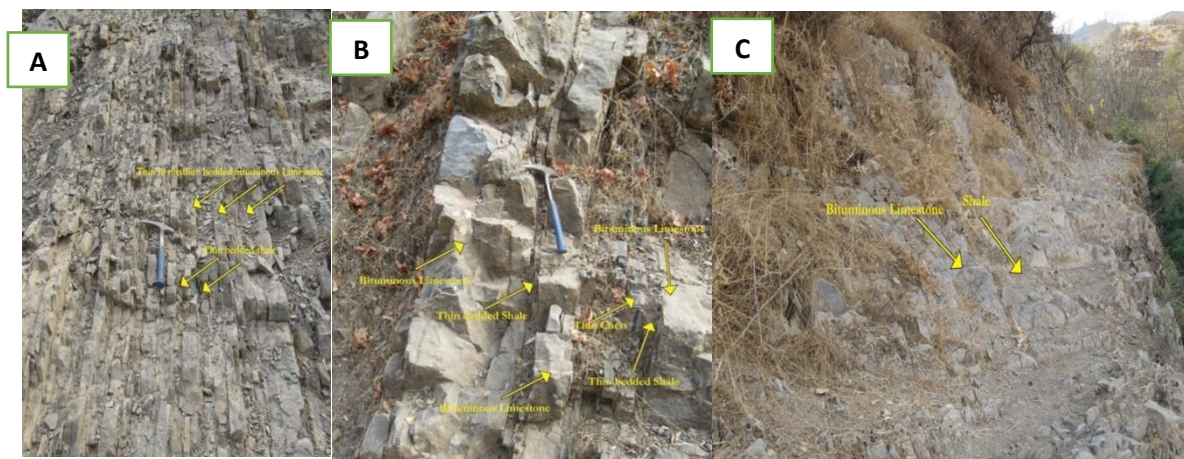


Figure 11- Parts of Sargelu Formation A. upper B. middle C. lower parts in Sargelu Section

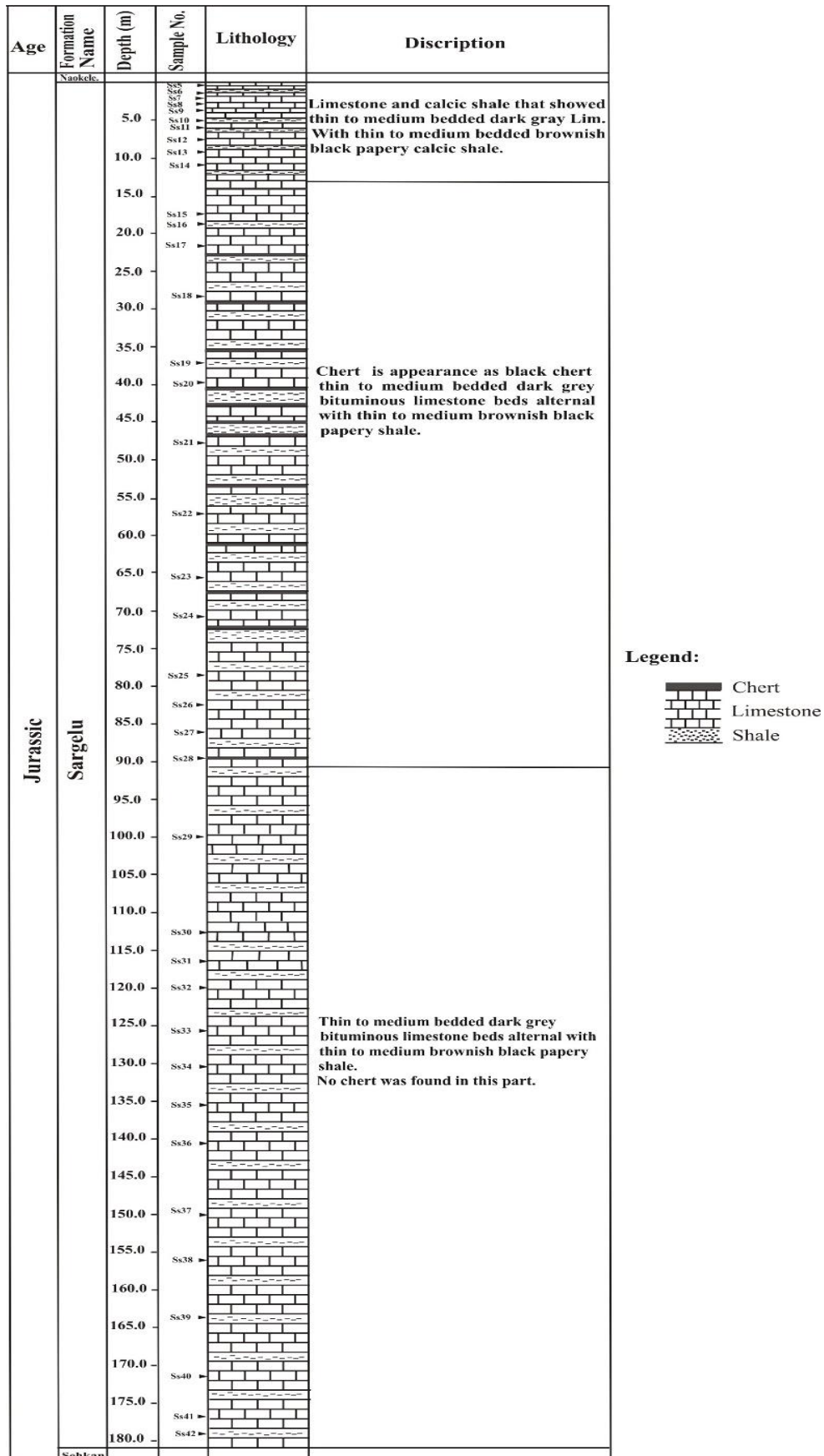


Figure 12-Stratigraphic column of Sargelu Formation, Sargelu Section

5. Conclusions

Sargelu Formation was deposited during the Middle Jurassic which represents one of the most important source rocks in Iraq and surrounding areas.

The lithostratigraphy of the Sargelu Formation was studied at Rania and Sargelu sections. Field observation and the correlation cross section (Fig.13) revealed the following: -

The thickness of the Sargelu Formation in the Rania section is 40 m which is divided into three lithologic units. The first is characterized by thin to medium bituminous limestone beds alternative with thin chert beds. This unit is divided into two subunit the upper includes bituminous limestone dominated with little chert beds. At the same time, the lower subunit shows chert beds dominated with limestone beds.

The third unit consists of thin to medium bituminous limestone alternative with fissility of gray shale.

The Sargelu section includes 180m of Sargelu Formation, divided into three units. The upper unit is characterized by consists of dark gray limestone beds and thin brownish-black of laminated shale. The middle unit includes the dark chert alternative with dark gray bituminous limestone and brownish-black laminated shale. In contrast, the lower unit consists of dark gray bituminous limestone alternative with medium brownish-black laminated shale.

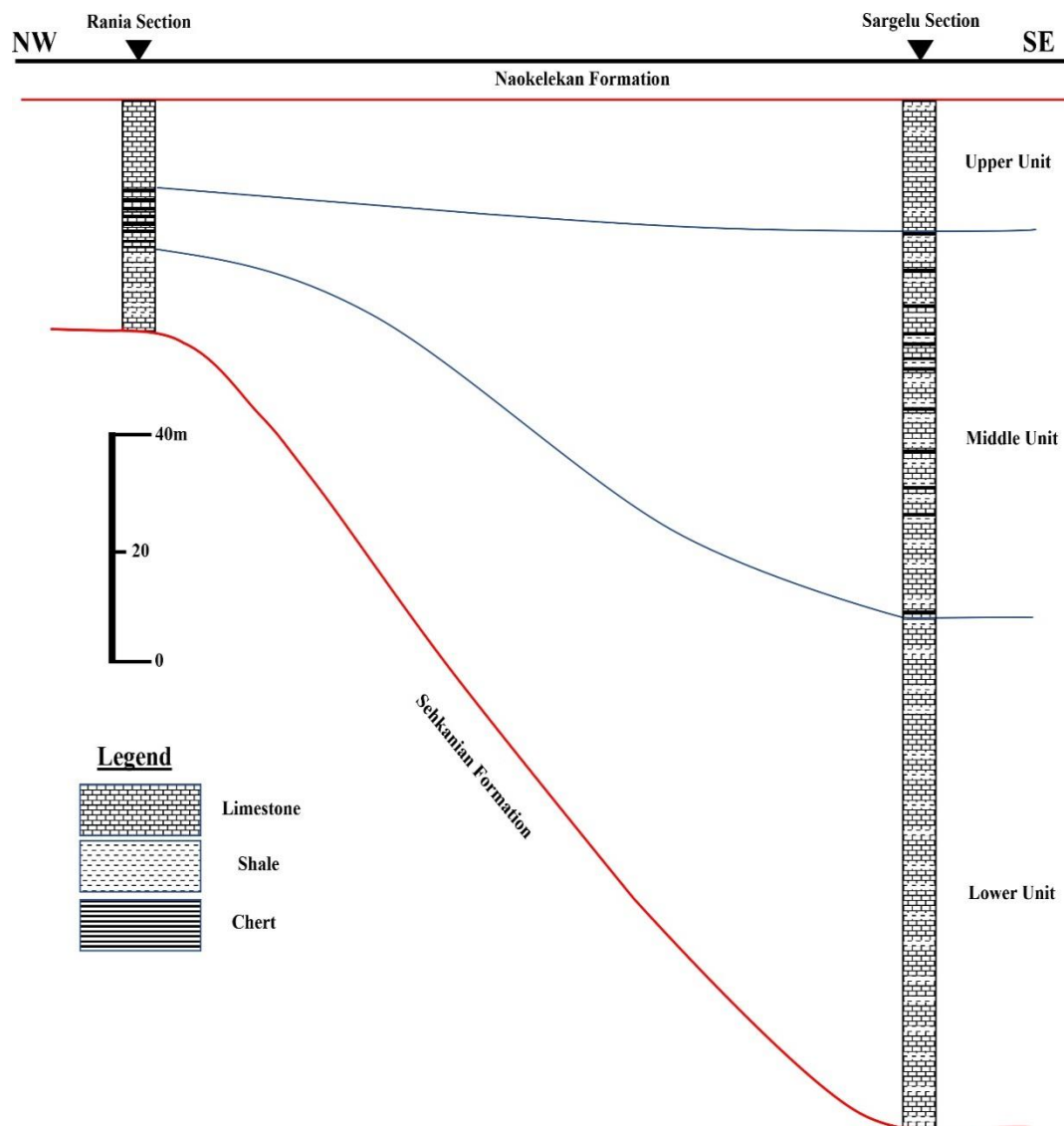


Figure 13-Lithologic cross section showing the correlation of the Sargelu lithologic units in Rania and Sargelu Sections.

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