PS The Derdere and Karababa Formations of Late Cretaceous Mardin Group in Cemberlitas Oil Field, Southeastern Turkey: Their Depositional Environment and Sequence Stratigraphy*

Oguz Mulayim[1] and Ibrahim Cemen[1]

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[1]Department of Geological Science, University of Alabama, Tuscaloosa, AL (oguzzmlym@gmail.com)

Abstract

The frontal belt of the southeastern Anatolian fold-thrust belt in Turkey contains several small to medium size oilfields, producing from the Cretaceous Mardin group carbonates. Many oil fields are located along the E-W to SW-NE trending, narrow and asymmetrical anticlinal structures which are associated with contractional faulting in the area. Cemberlitas oil field (COF) in Adiyaman, southeastern Turkey is one of the most important oil fields in the region. The Upper Cretaceous Derdere and Karababa formations of the Mardin Group are the main reservoir and source rocks in the oil field. We have conducted a detailed microfacies analysis and determined depositional environments and sequence stratigraphy of the Derdere (Mid- Cenomanian-Turonian) and Karababa (Coniacian-Lower Campanian) in the Cemberlitas oil field. Based on our interpretation of available well logs, we interpreted thin sections prepared from core and well cuttings of 8 exploration and production wells in the study area. We have recognized the presence of 8 microfacies in the Derdere and Karababa formations. (1) Fine crystalline dolomite, (2) Medium-coarse crystalline dolomite, (3) Bioclastic wackestone/packstone,(4) Lime mudstone, (5) Phosphatic-glauconitic planktonic wackestone, (6) Planktonic foraminiferous wackestone/packstone, (7) Dolomitic planktonic wackestone, (8) Mollusk-echinoid wackestone/packstone. These microfacies suggest that the Derdere Formation was deposited in a shallow marine lagoonal to shelf depositional environment. The microfacies analysis indicates that Karababa Formation was deposited in a deep to shallow marine intrashelf depositional environment. We have identified two-third order sequences. The transgressive deposits display a predominance of deep subtidal facies, while highstand deposits show shallow subtidal facies. These boundaries are: Late Turonian (Sb1) and Lower Campanian (Sb2). Each depositional sequence shows transgressive (TST) and highstand (HST) system tracts and packages of facies. These sequences are compared with those of neighbuoring areas to differentiate local, regional and global factors that controlled sedimentation within the study area.

THE DERDERE AND KARABABA FORMATIONS OF LATE CRETACEOUS MARDIN GROUP IN CEMBERLITAS OIL FIELD, SOUTHEASTERN TURKEY: THEIR DEPOSITIONAL ENVIRONMENT AND SEQUENCE STRATIGRAPHY

THE UNIVERSITY OF ALABAMA

MULAYIM OGUZ and CEMEN IBRAHIM

Department of Geological Science, University of Alabama, Tuscaloosa ,AL 35487

Abstract

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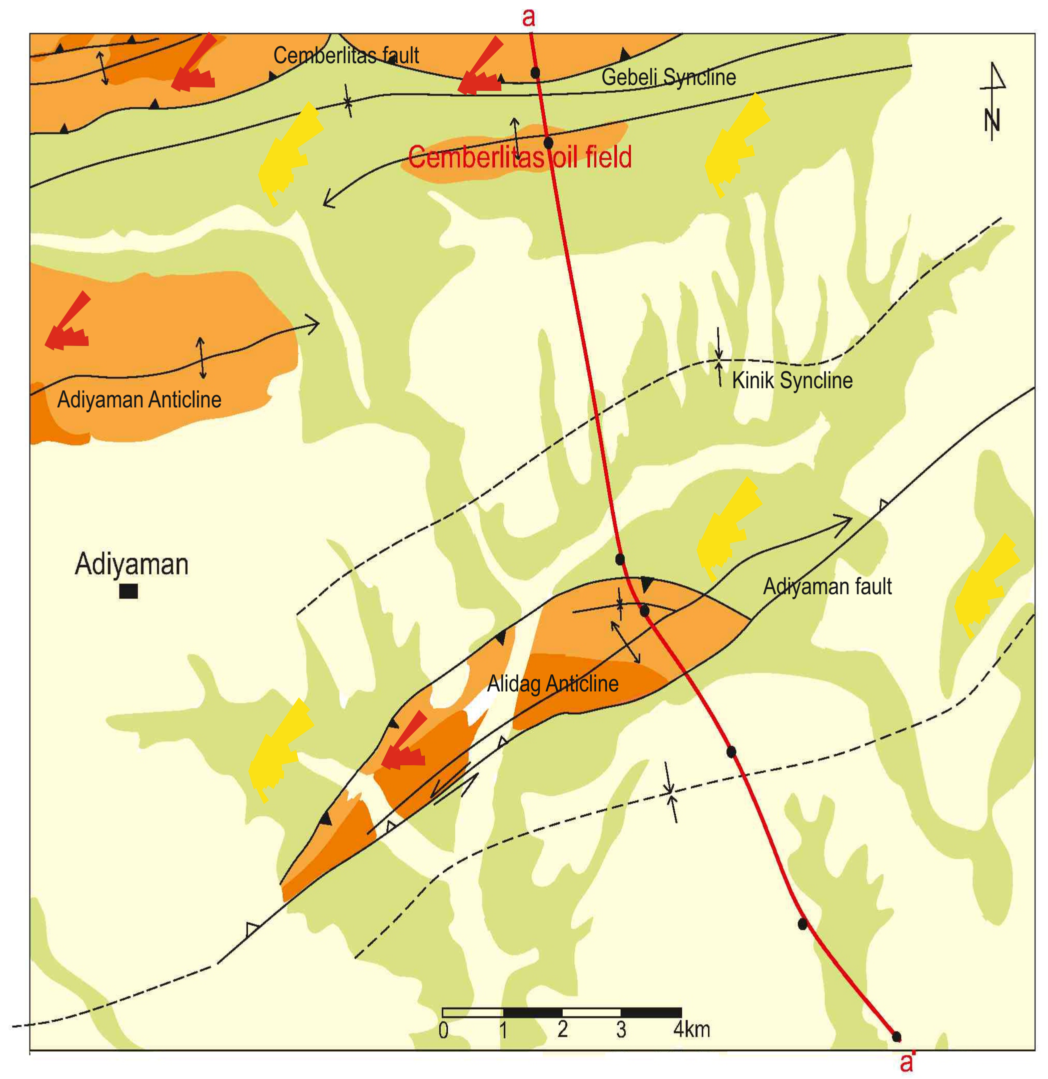
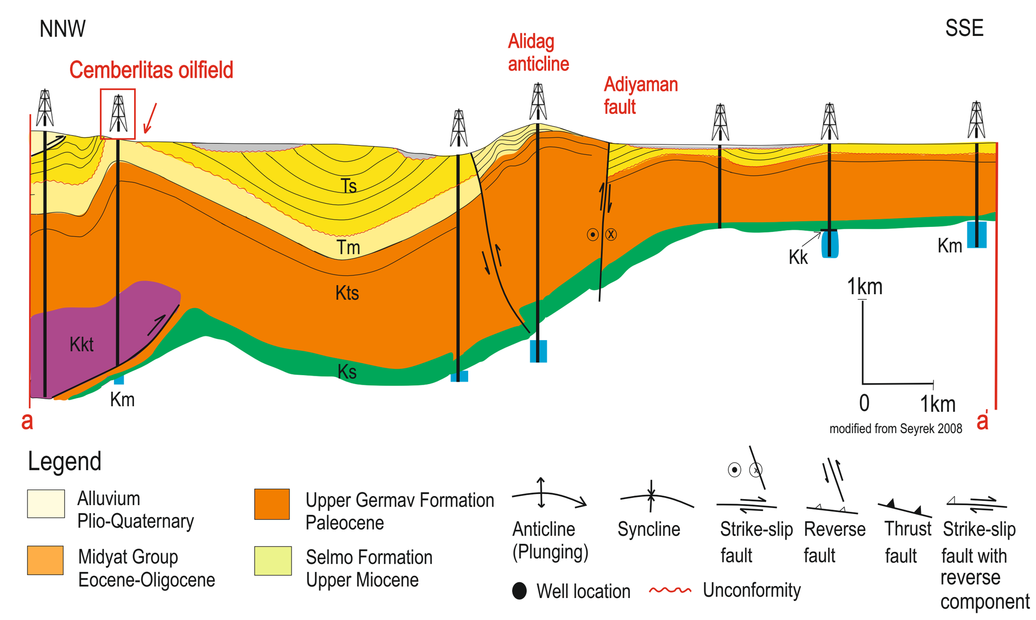
Geological Setting of Cemberlitas area



modified from Guven ,1991



Red rose diagrams for the suface bedding plane measurements of the Paleocene-Oligocene Upper Germav Formation and Midyat Group show that there are two dominant strikes are around N45E and N75E orientations.

Blue rose diagrams for the surface bedding plane measurements of the Upper Miocene Selmo Formation shows that the dominant strikes are around N50E orientations.

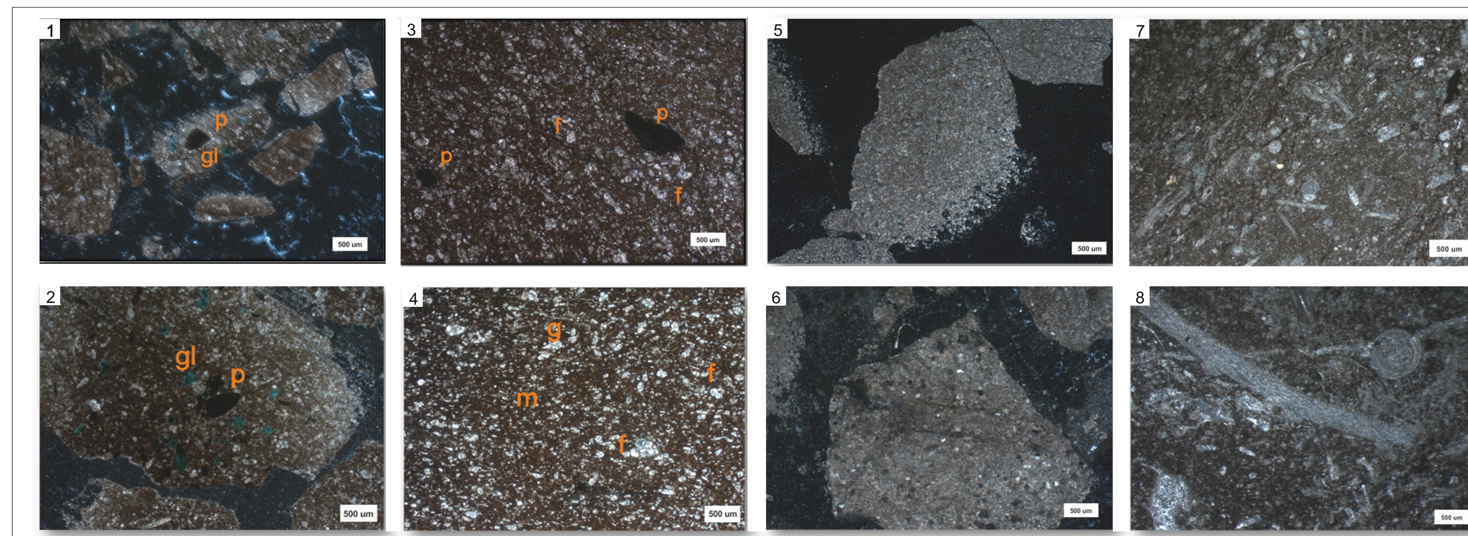
Large scale anticline trending northeast-southwest formed during Miocene tectonics.

The east to southwest dipping layers form asymmetric anticlines in the field.

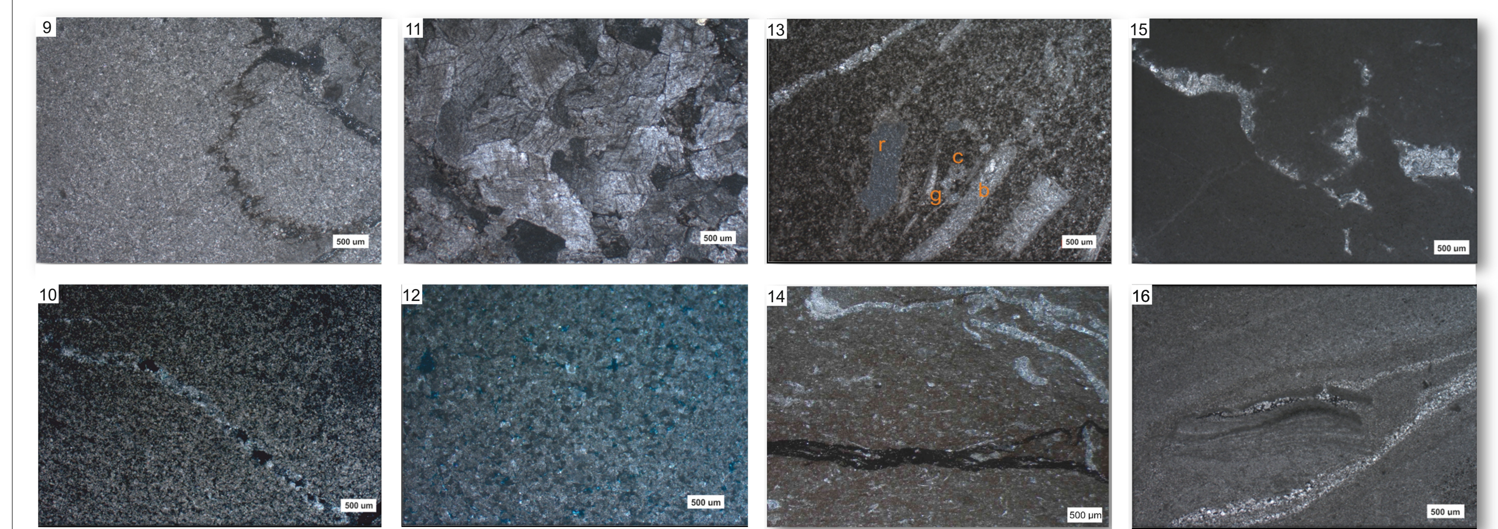
The Cretaceous allochtonous complex thrust from NW to SE. Complex was cut only in the northern wells.

The basin was deeping towards north according to the formation depths and the thicknesses.

Microfacies Analysis of Karababa and Derdere formations

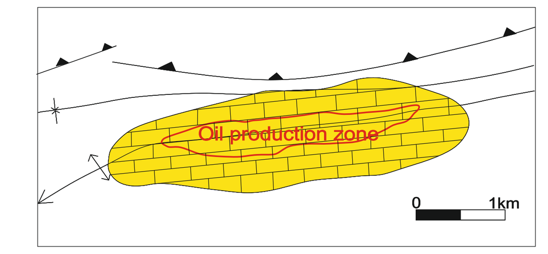


Microfacies types of the Karababa Formation. 1-2. Phosphatic-glauconitic planktonic wackestone Mf8 (Sample no O32). 3-4. Planktonic foraminiferous wackestone/packstone Mf7 (Sample no O45). 5-6. Dolomitic planktonic wackestone Mf6 (Sample no O54). 7-8. Mollusk-Echinoid wackestone/packstone Mf5 (Sample no O34). gl. glauconite, p. phosphate, f. foraminifera, m. mollusk.

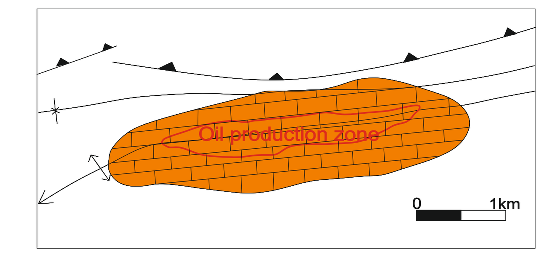


Microfacies types of Derdere Formation. 9-10. Fine crystalline dolomite Mf1 (Sample no O13). 11-12. Medium-coarse crystalline dolomite Mf2 (Sample no O16). 13-14. Bioclastic wackestone Mf3 (Sample no O21). 15-16. Lime mudstone Mf4 (Sample no O25). c. crinoid, g. gastropode, b. bivalve.

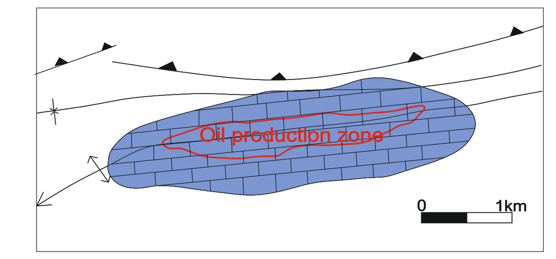
Carbonate Facies Distribution



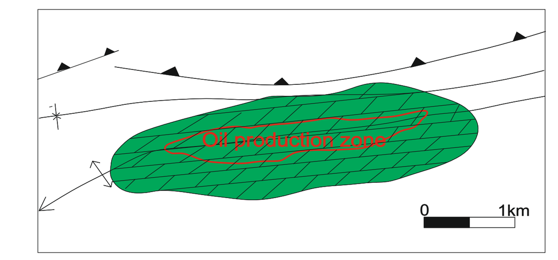
Lagoonal carbonates (Karababa-C Member) Mid Santonian -Early Campanian



Organic-rich limestones (Karababa-A Member) Late Coniacian-Early Santonian

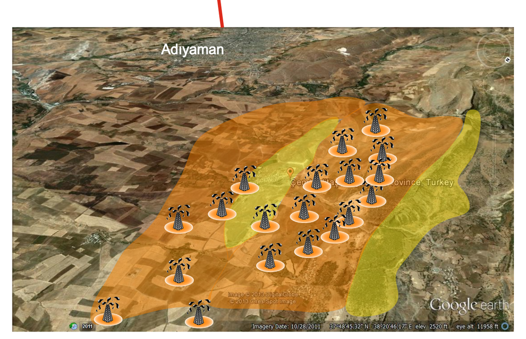


Restricted (lagoon) carbonates (Derdere Formation) Late Cenomanian-Turonian



Dolomite facies (Derdere Formation) Mid Cenomanian

Location



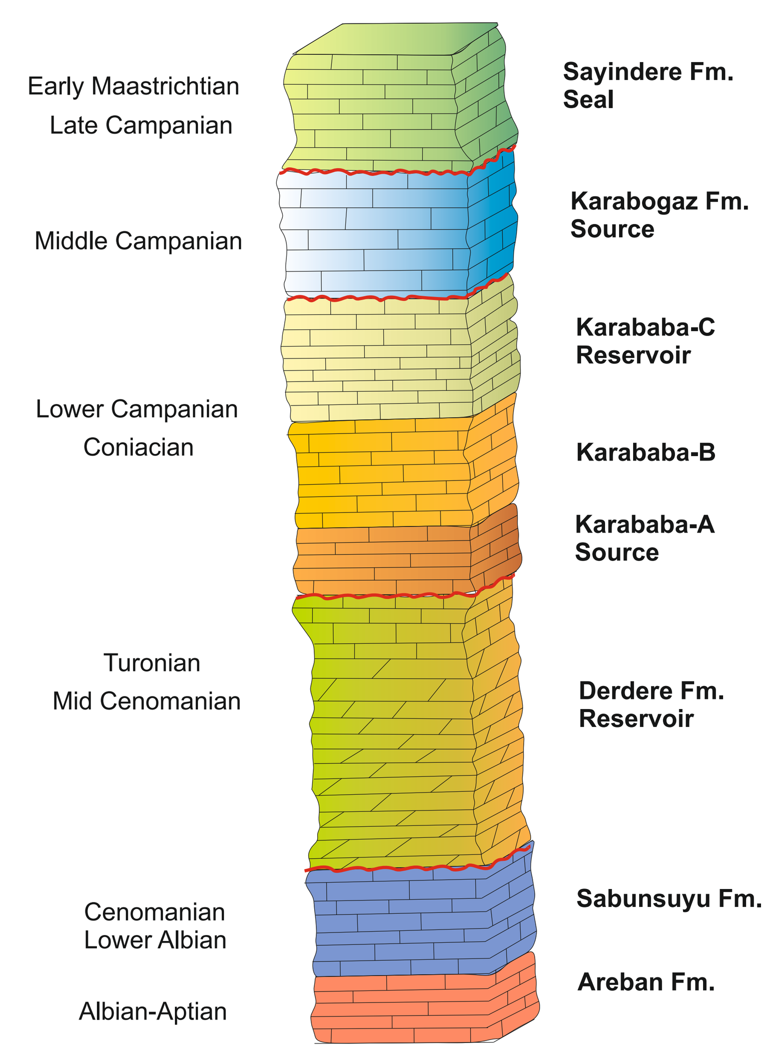
Tectonic units of SE Turkey and location of the Cemberlitas oilfield

The Upper Miocene overthrust belt in the north is characterized by regional metamorhism resulted in large scale uplifts and formation of nappes.

The Upper Cretaceous overthrust belt is characterized by imbricated, east-west narrow, asymmetrical thrusted anticlines forming the major oilfields in Turkey.

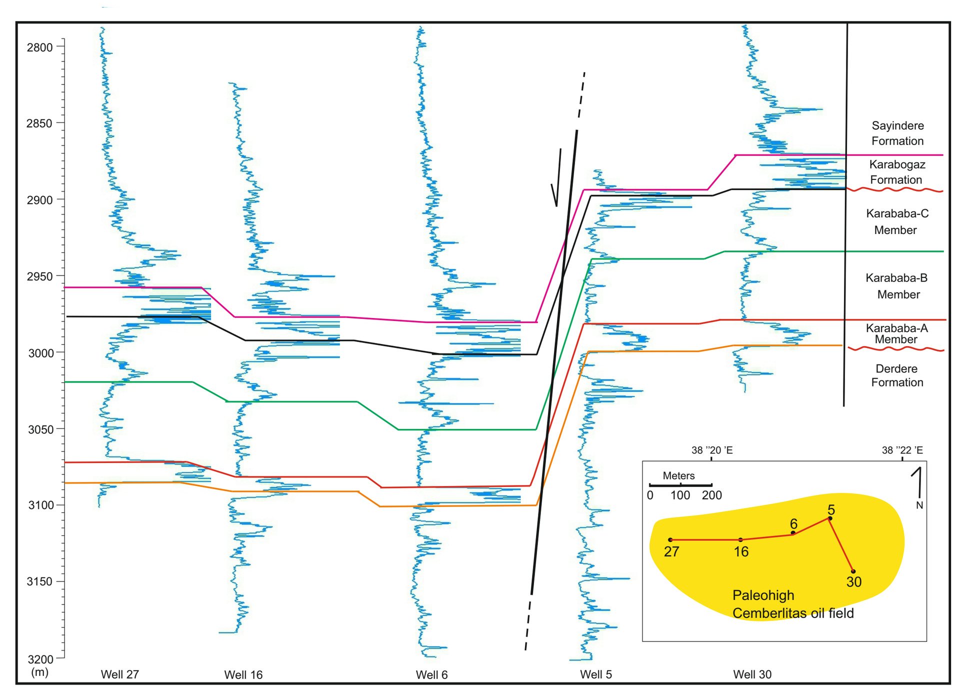
The foreland is located to the south with large anticlines bordered by steep reverse and normal faults.

Upper Cretaceous Cemberlitas Stratigraphy



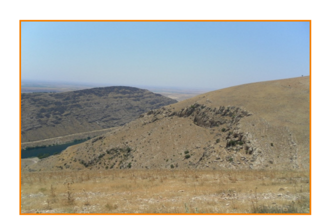
Stratigraphic column showing formation of the Mardin and Adiyaman carbonate group exposed in the study area.

GR logs correlation



In the Cemberlitas oil field ,there are two distinct reservoir intervals separated by source rocks

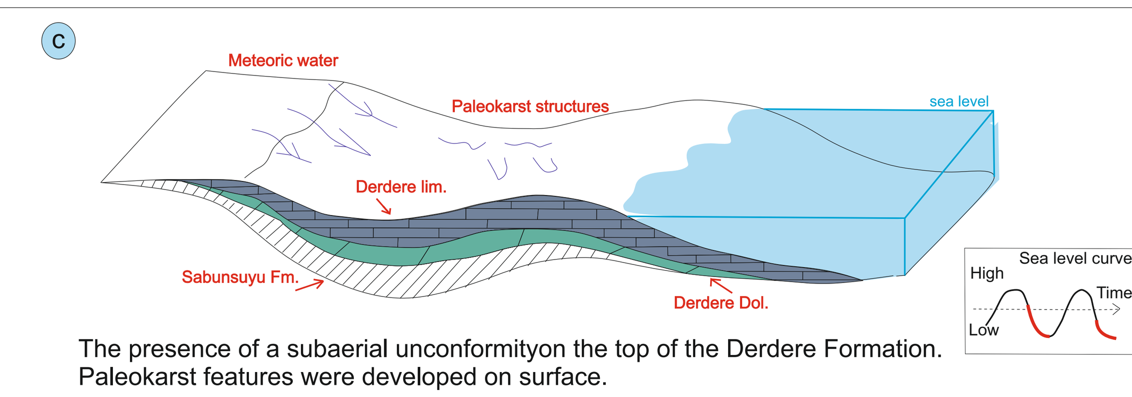
Grayish yellow rigidly fragile,lower graded abundant organic matter ,thin bedded limestone



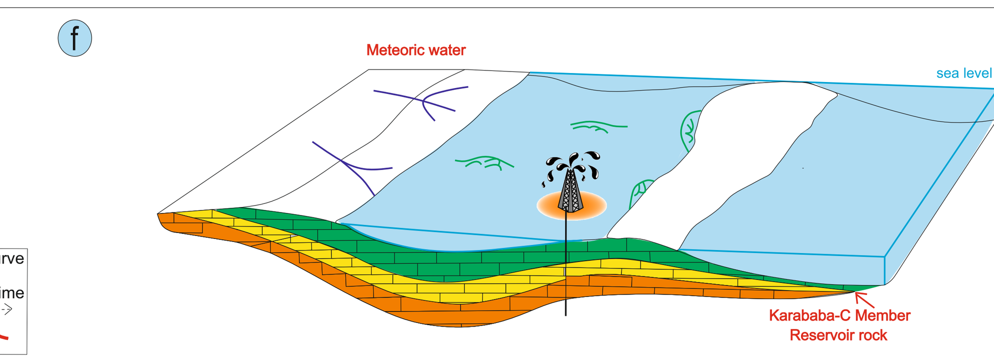
Dark brown grayish spherodial fossil abundant organic material tight thin calcite veinlet phosphate and glauconite limestone

Dark grey ,micritic nodular interbedded chert abundant planktonic foram partly silicious phosphate massive limestone

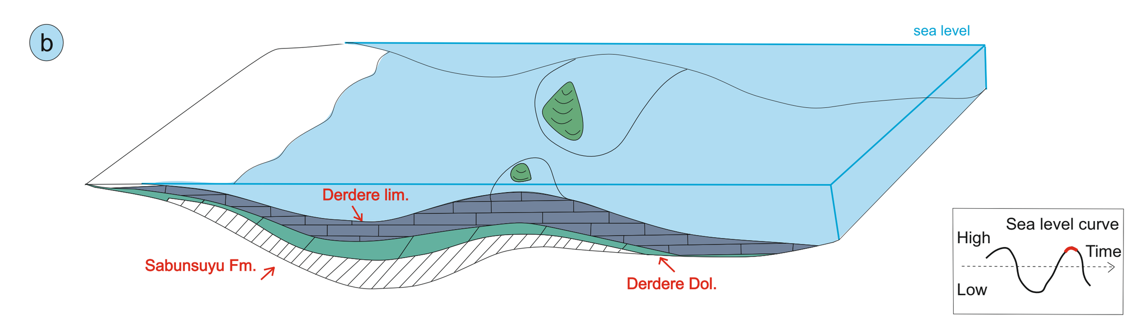
Depositional models of Derdere and Karababa formations



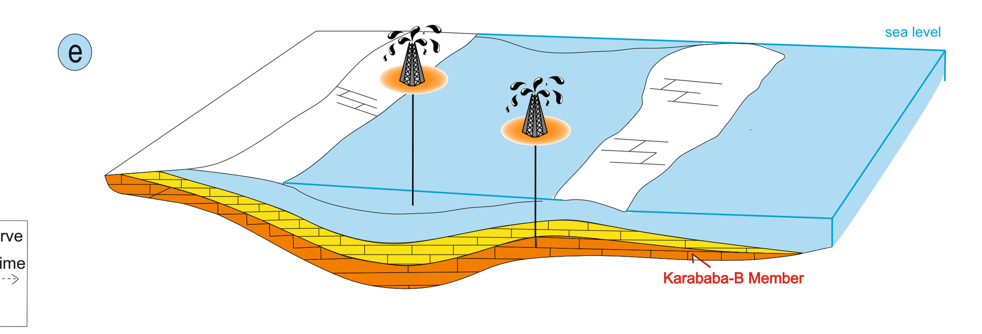
The presence of a subaerial unconformityon the top of the Derdere Formation. Paleokarst features were developed on surface.



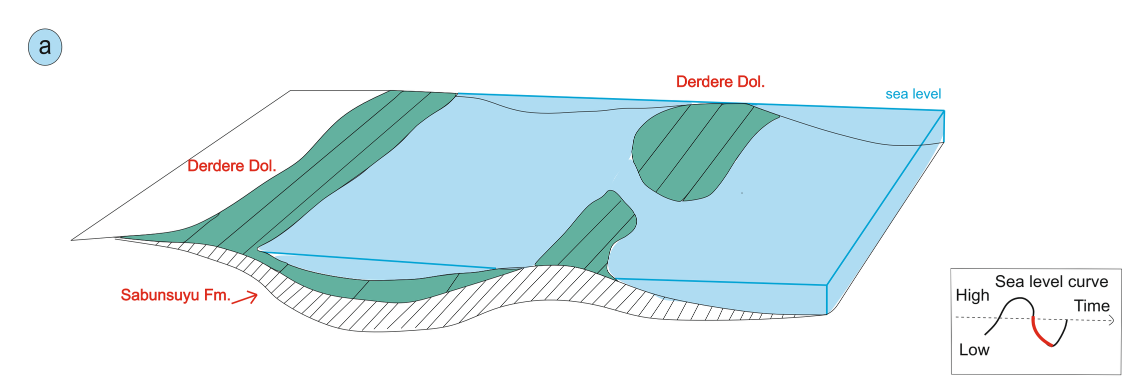
Karababa-C Member sedimentation covered intrashelfbasin as sea level reach minimum



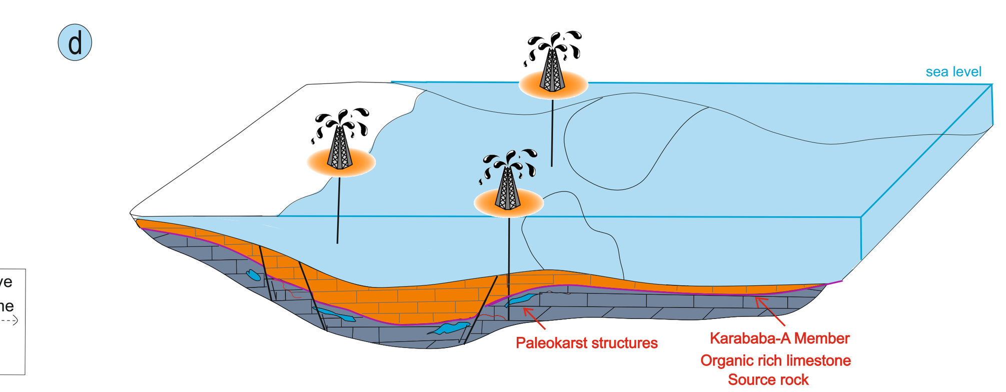
Green areas are bivalve banks. Shallow lagoonal Derdere limestones.



Slowing rate of sea level rise caused the margin carbonates to catch up and also a caused a decrease in organic carbonate depostionwith feeding dolomite grains (Karababa-B Memeber).



Sabunsuyu Formationdolomites at the bottom parts.
Fine crystalline and medium coarse crystalline dolomite-intertidal-subtidal environment.



Relative deeping of the basin and deposition of organic rich carbonates (Karababa-A Member) under anoxic conditions

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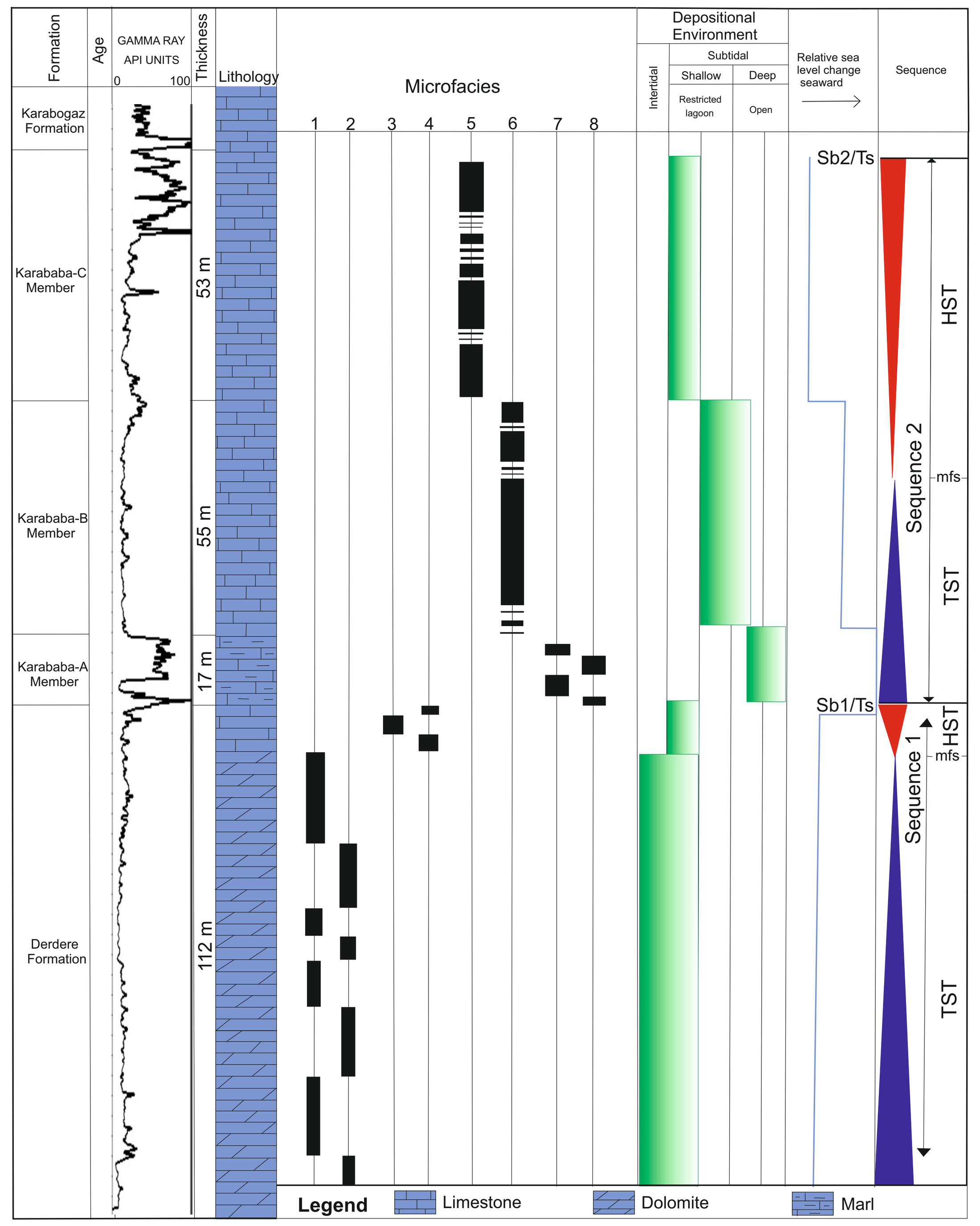
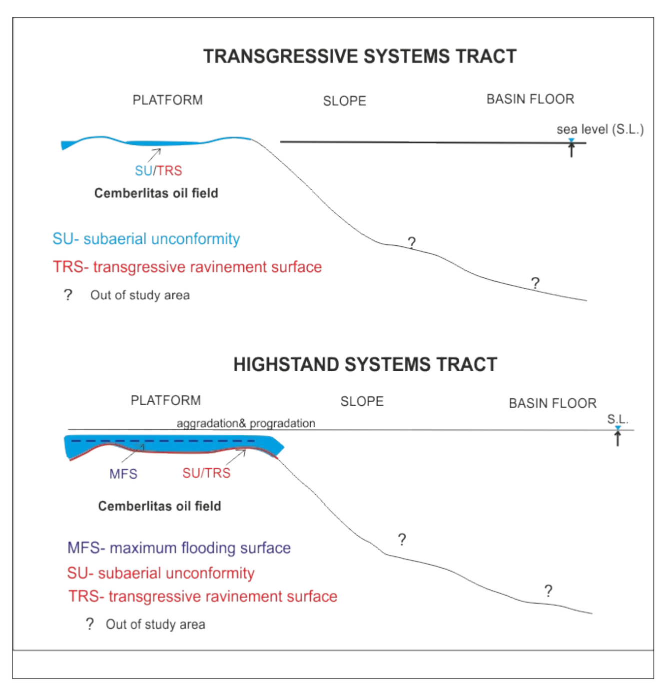
Sequence Stratigraphy Framework





Subaerial unconformity;

A surface of erosion or non-deposition created generally during base-level fall by subaerial process.

Ther timing and mode of formation it correspond to the largest stratigraphic hiatutes.

Maximum Flooding surface;

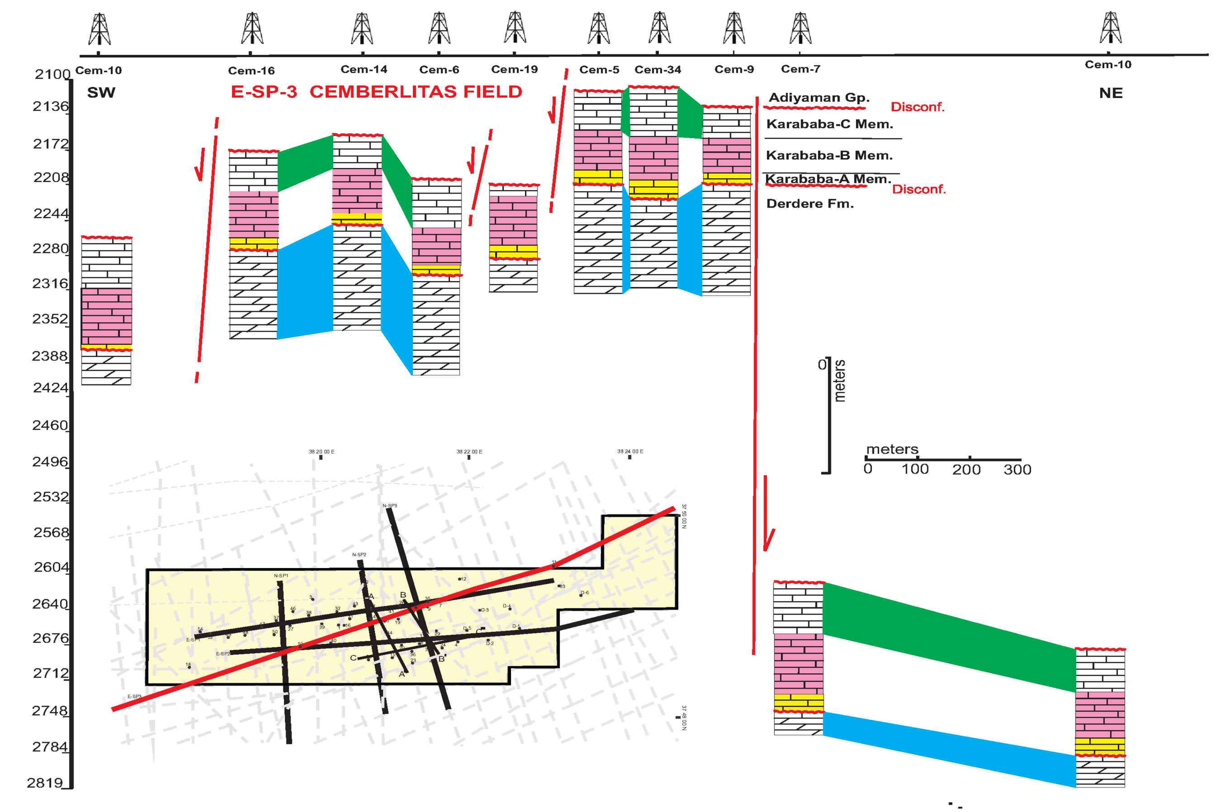
Caps the transgressive system tracts

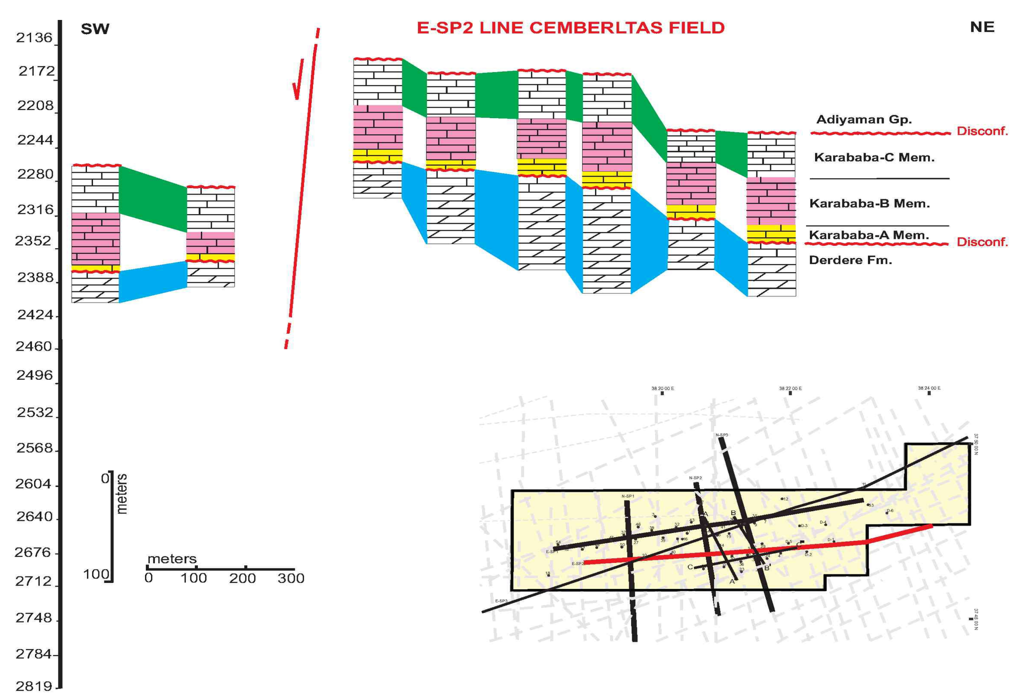
Represents the last of the significant flooding surfaces found in the transgressive system tract.

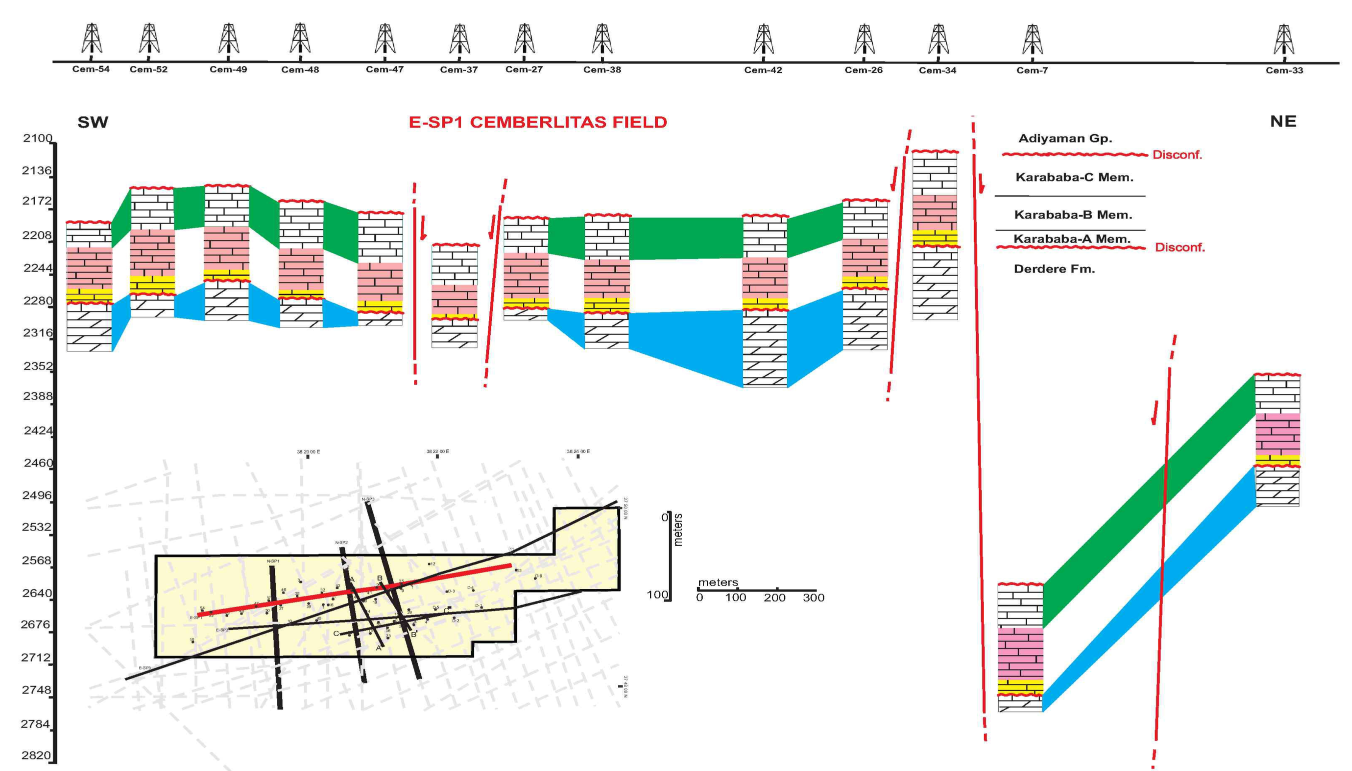
Commonly characterized by extensive condensation

The TST is underlain by the transgressive surface (ts) and overlain by the maximum flooding surface (mfs), which records the deepest water conditions within the sequence.

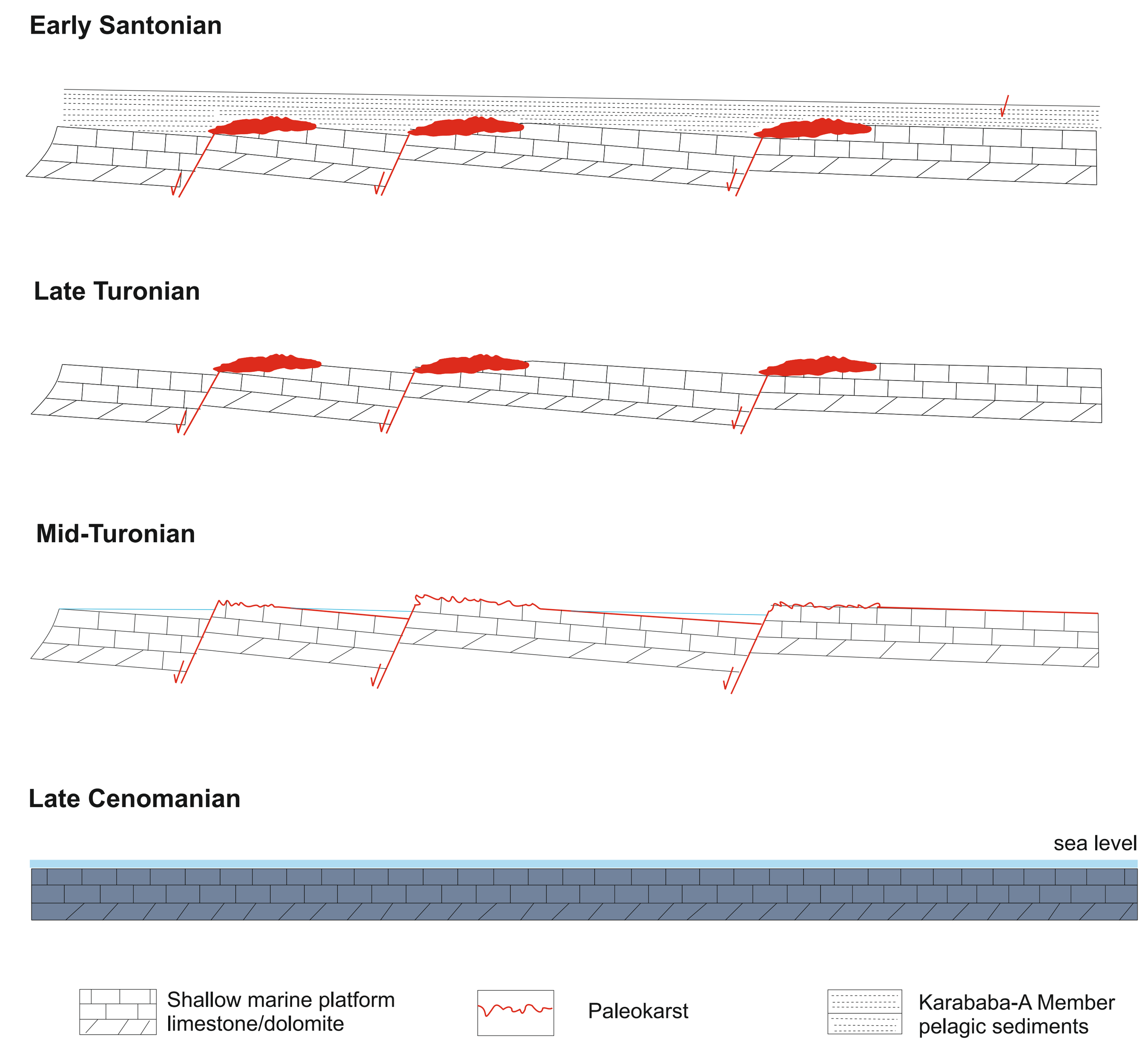
The HST is commonly capped by an unconformity at the sequence boundary (sb), which records prolonged subaerial exposure and erosion.

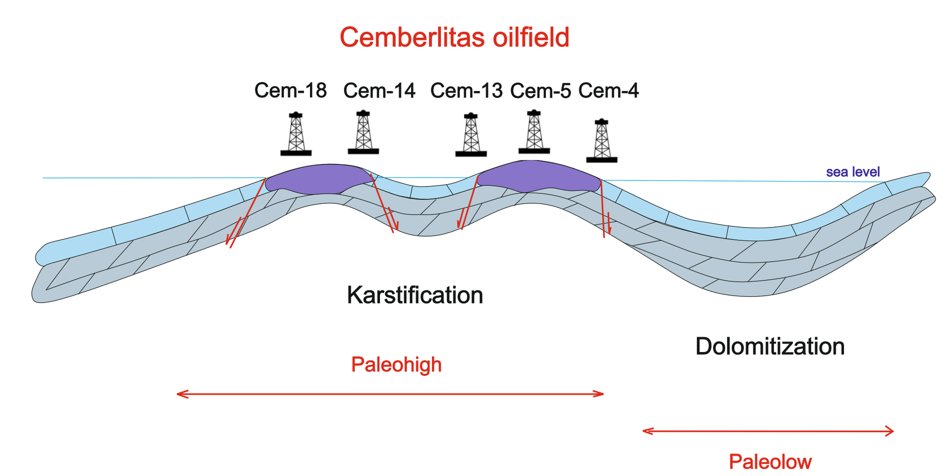


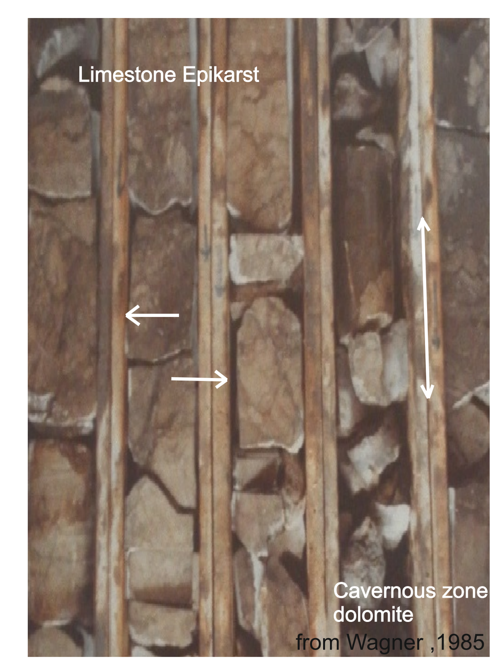




Tectono-Karst Model







Karstification can occur in Cemberlitas paleohigh and similar realms,including meteoric and mixing zone.

Karst development in the Derdere Formation occured extensively on emergent portions of lagoonal environment.

Subaerial exposure related features in the Derdere Formation seen in Cemberlitas oilfield core section include; solution widened fissures, collapse breccia, vugs and cave floor deposits are commonly occuring features

Breccia related to dissolution of carbonate rock is widespreadin this area.

Summary of Karstification

Paleokarst breccia appears to be mainly located in the upthrown side on extensional faults. The structural highs of these tilted blocks could have been temporarily emergent to cause karstification. Some of the analyzed karstic morpologies could correspond to large dissolution voids called flank margin caves (Wagner,1985). These structures formed preferentially in the area of the discharging margin of a freshwater lens resulting from freshwater/sea water mixing or in relation to fracture systems. Evidence for this interpretation includes a drowningplatform, mainly related to tectonic collapse by normal faults and a sea level rise that was preceded by a phase of emersion and karstification. In some places a prolonged phase of erosion in the pelagic realm, mainly current -related, is responsible for reducing sedimentation rate and causing erosion of the surface.The higher elevations of the normal faults were most likely affected by current activity strong enough to locally erode previous sediments, or to totally hinder sediment acumulation for longer time spans than in the lower parts of these blocks. Rapid block tilting to significantly low dip angles on the fault blocks is envisaged as a major cause of the presence of non-deposition areas together with low-sedimentation areas. As a result of that, starved pelagic carbonate environments occured during the depostion of the Karababa-A Member. In these settings unconsolidated carbonate mud cannot accumulate on slopes steeper t han 2 to 5 degrees (Molina et al., 1999). Tectonic and eustatic sea level fluctuations were the two main factors causing fault block emersion (emergence or subemergence). Relative sea level, (rises or falls), associated locally with fault block emersion, were followed by relative sea level highstands and the renewal of sedimentation. Detailed analysis of the paleokarst correlative paraconformity surfaces has provided great precision in the dating of the events controlling the genesis of all these features. There are other well described examples of paleokarst in the world. One of these examples is the long term karstification in the Turonian limestones of Israel (Buchbinder et al., 1983).

Conclusions

8 microfacies identified based on extensive petrogtaphical thin seciton study.

Derdere Formation was deposited in a shallow marine lagoonal to shelf depositional environment.

Karababa Formation was deposited in a deep to shallow marine intrashelf depositional environment.

The subaerial exposure are associated mainly with the regional Turonian unconformity.

Based on microfacies analysis and sequence stratigraphy concepts, two-third order sequences in the subsurface section were identified. The transgressive deposits display a predominance of deep subtidal facies ,while highstand depostis show shallow subtidal facies. These boundaries are: Late Turonian (Sb1) and Lower Campanian (Sb2). Each depostional sequence shows transgressive (TST) and highstand (HST) systems tracts and packages of facies.

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Wagner ,C ,.and Pehlivanli ,M.)1985(. Karst geological interpretation of the Mardin carbonates in the Cemberlitas oil field .A plot . TPAO report no .2051.