Lower Cretaceous Turbidites of the Pontides and the Opening of the Black Sea*

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Abstract

A huge Lower Cretaceous submarine turbidite fan, measuring 300 km by 60 km crops out in the Central Pontides in northern Turkey and extends north to the Black Sea. The turbidite fan is known as the Çağlayan Formation in the east and the Ulus Formation in the west. Both of these formations have source and reservoir characteristics and have been drilled onshore for hydrocarbons. Geological field studies and clastic zircon U-Pb dating in the sandstones have shown that the Çağlayan and Ulus formations are deposits of the same basin, which to a large extent was sourced from the Ukranian shield north of the Black Sea. This implies that during the Early Cretaceous (Barremian-Aptian) there was no “Black Sea” between the Pontides and the East European Platform. A second implication is with regard to the reservoir characteristics of the sandstones in the Çağlayan (Ulus) Formation. Previously, the source for the Lower Cretaceous turbidites was considered to lie in the south, in the large metamorphic area south of the Central Pontides, which is made up predominantly of phyllite and metabasite. New Ar-Ar age data have shown that this metamorphic area is largely of Early Cretaceous age, and therefore cannot be a source for the Çağlayan (Ulus) Formation. Hence, the sandstones in the Çağlayan (Ulus) Formation were largely sourced from the granites and gneisses of the Ukranian shield and may have suitable reservoir characteristics, a major problem in the Black Sea petroleum exploration. We envisage a large river system draining the Ukranian shield south to the Tethys ocean via the Central Pontides. A major phase of deformation, metamorphism and uplift occurred during the Albian in the Central Pontides. The distal parts of the Barremian-Aptian turbidite fan, which extended south to the Tethyan ocean, was entrapped in the subduction zone and was
metamorphosed. Oceanic crustal rocks metamorphosed in the eclogite and blueschist facies during the Albian were accreted to the southern margin of Laurasia. Turonian to Coniacian-Santonian pelagic limestones lie unconformably over the deformed Lower Cretaceous turbidites and mark the opening of the Black Sea basin.

Selected References


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Shelf sediments
Basinal clastics
Source of the turbidites
Detrital zircon geochronology by ICP-MS
Depositional area of the Çağılayan Group

Late Neoproterozoic

Paleoproterozoic-Archean
Pan-African Neoproterozoic zircons

Archean Palaeoproterozoic zircons

Gondwana-derived zircons
Carboniferous sandstones, Pontides

– Okay vd (2010)

age gap 700 - 1700 Ma
Zircons from Lower Cretaceous sandstones

n=310

Don River zircons
n=81
Safonova et al. 2010
Sediment supply
Early Cretaceous (Barremian - Aptian) 130-110 Ma

Depositional area Of the Çağlayan Group

EAST EUROPEAN CRATON

Scythian Platform

Crimea

Mid-Black Sea Ridge

Sakarya Zone

Greater Caucasus

Lesser Caucasus

Donbas Foldbelt

Karpinsky Swell

Dobrugea

Moesia

Strandja Massif

İstanbul Zone

Tethyan ocean

25 km/my
Çağlayan Group distal turbidites
Slate and phyllites
Conclusions

1. A Early Cretaceous submarine fan on the southern margin of Eurasia fed by major river/s.

2. Distal turbidites of the fan were entrained in a subduction zone and were metamorphosed in the Early Cretaceous.

3. Metamorphic area in the southern Central Pontides previously considered Triassic and older, is of Cretaceous and Jurassic in age.

4. There was no Black Sea basin in the Early Cretaceous.

5. Early Cretaceous rifting and Late Cretaceous opening of the West Black Sea Basin are probably separate events.

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Depositional area of the Çağlayan Group

Late Neoproterozoic

Paleoproterozoic-Archean
Sediment supply

Atlantic Ocean

Avalonia

Variscan Front

Trans-European suture

Variscan suture

Rheic suture

Tethyan suture

Arctic Ocean

African Platform

Atlantic Ocean

Europe

Baltica

Eurasia

Black Sea

Sediment supply

Mediterranean

500 km

AFRICA (GONDWANA)