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Lithofacies variability in the Lower Khvalynian sediments of the North Caspian Sea region.

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The Early Khvalynian period (∼15 500–12 500 cal years B.P.) is characterized by continuous dynamic changes in North Caspian Sea region environment, which has been confirmed by numerous data obtained during the lithofacies analysis of its key sections.
Lithofacies complex of the North Caspian Sea region contains four subfacies – clayey, laminated, sandy-clayey and aleurite-clayey.
Clayey facie is characterized by absolutely clayey structure with massive nonlamellated or subfissile dark-brown clays and rarely contains thin aleurite layers. This subfacie is one of the most widespread in the North Caspian Sea region. Clayey facies are typical for the most of the key sections in the Middle Volga (Bykovo, Torgun, Rovnoe, Novoprivolnoe, Chapaevka), Lower Volga (Svetly Yar) and on the left side of the Volga River valley (Verkhny Baskunchak, Krivaya Loshchina, Bolshoy Liman). Deep paleodepressions of the Lower Volga and the left side of the Volga River valley are also characterized by the maximum of the average clays thickness, which can reach up to 10 m.
Sandy-clayey subfacie is characterized by stratified structure with horizontal and lenticular lamination of clays with sandy-aleuritic interlayers. The average thickness of sand layers is 2-5 cm. At most of the key sections thickness of clay layers is up to twice larger than the sands layers and only on depressions' periphery can be exceeded by some terrigenous interlayers.
Sandy-aleuritic parts of clays have different mineral structure. Light suite is dominated by quartz and feldspar with some debris of heavy minerals, glauconite and calcite. Fraction of the heavy minerals contains titano ferrite, epidote, granite, zircon, amphibole, rutile, disthene, tourmaline, sillimanite. Layered subfacie is the most abundant among the chocolate clays and is widespread in the Lower Volga River region and the Ural River valley, but sporadic in Kalmykia and the Volga Delta.
Sandy-clayey and aleurit-clayey subfacies have rare distribution. Sandy-clayey subfacie (Raigorog section) contains two patches of clays, that are interbedded by thick sandy layer with khvalynian mollusks shells. Aleurite-clayey subfacie is typical for the upper part of the Volgian estuary (Chapaevka, Torgun). During the Early Khvalynian transgression only clayey-aleuritic deposits, which represent the Early Khvalynian period, accumulated in flooded territory of the Volga river valley.
On the most part of investigated territory facies are presented by clays (chocolate clays), which are predominantly located in the middle part of the Early Khvalynian sections and constrained by sands with mollusk shells on its bottom and top. These facies are very common in the bottom part of the sections in the Lower Volga region, while in the Middle Volga region clays are dominated in all segments of the Khvalynian strata. But these clays can't be classified into an individual stratigraphic layer as they don't contain index mollusks and have different stratigraphic location.
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