CLIMATIC AND OTHER CONTROLS ON THE DEPOSITION OF THE LOWER AND MIDDLE PRODUCTIVE SERIES, AZERBAIJAN

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Outcrop studies of the lower and middle Productive Series in the Kirmaky Valley on the north side of Baku, Azerbaijan indicate that climatic fluctuations profoundly influenced the accumulation of reservoir sandstone of Miocene (?) and Pliocene age in the northern part of the South Caspian basin. Variations in precipitation and temperature determined the nature and volume of clastic input as well as the level of the proto-Caspian Sea.

Paleontologic and sedimentologic evidence suggests that lake level repeatedly rose and fell during deposition at frequencies that ranged from 106 to 104 years. The 1st-order cycle (using a hierarchy of cycles specific to the South Caspian basin) encompasses the transition from late Miocene (Pontian) marine shale through the predominately shallow-water and non-marine deposits of the lower Productive series and return to deep marine deposition in the Pleistocene (Apsheronian). 2nd-order cycles reflect broad fluctuations in lake level at frequencies on the order of several 105 years and are manifested by the alternation of predominantly fluvial (Pod-Kirmaku, Nad-Kirmaku, Pereryva and Balakhany sandstones) with predominantly lacustrine (Kirmaku Suite, Pereryva and Kalakhany shales) successions. 3rd-order cycles are intermediate between these cycles and the highest frequency (4th-order) cycles. The latter fluctuations probably represent a few 104 years, perhaps at a Milenkovich frequency. Superimposed on, and associated with the lake-level changes are fluctuations in sediment input. Tectonic influences on the accumulation of the lower and middle Productive Series are harder to define but may be represented by shifts in facies that appear to be unrelated to climatic variation.

Deposition of the Productive Series in the Kirmaky Valley began with fluvial Pod-Kirmaku (PK) sandstone, atop an unconformity probably created by tectonic activity. Within the limited exposure of these deposits no indications of higher frequency fluctuations exists. Expansion of the proto-Caspian Sea inundated the fluvial sandstones and led to a prolonged period of largely lacustrine deposition of the Kirmaku Suite (KS). Within the 300 meters of KS section in the Kirmaky Valley are some 30 to 40 amalgamated sandstones up to several meters thick that apparently were deposited by sheet floods during lowstands of the lake. These amalgamated sets define 4th-order cycles, and are grouped in clusters that probably represent 3rd-order cycles. The KS is most shale-rich in its middle part, where microfossils suggest at least episodic connections with the Black Sea. In this part of the section, however, repeated horizons containing rootlet structures document episodic drying of the lake, suggesting substantial high-frequency lake-level fluctuations of substantial magnitude. The shaley interval probably represents a 2nd-order highstand during which 4th-order fluctuations of lake level were particularly dramatic. Sands at the top of the KS, like those at its base probably represent prograding shorelines or deltas. A laterally extensive erosional surface separates these deposits

from overlying fluvial sands of the Nad-Kirmaku sand (NKP) in which climatic fluctuation is not obvious. Another erosional surface separates the NKP from the overlying Nad-Kirmaku shale (NKG). Repeated horizons of large desiccation cracks in the NKG and an absence of lacustrine microfossils indicate deposition under conditions of subaerial exposure, perhaps during episodes so dry that sand input was minimal and lake level was particularly low.

The middle Productive Series in the Kirmaky Valley are dominated by fluvial deposition. A pronounced erosional surface separates the NKG from overlying fluvial sheet sands of the Pereryva. Conglomerate at the contact suggests an increase in slope gradient, possibly as a result of tectonic activity. Laterally extensive erosional surfaces, spaced at intervals of 5-20 m within the Pereryva, may represent 3rd- or 4th-order cycles, as do alternations of fluvial and probable eolian sand in the Balakhany. Lacustrine shale intervals at the top of the Pereryva and within the Balakhany reflect broader (2nd-order) rises of lake level. The larger of these lake level rises follow episodes of aridity like that characterizing the NKG.