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Recent geodynamics and evolution of the Moma rift, Northeast Asia.

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The Cenozoic Moma rift system is a major tectonic feature in northeast Russia. It is composed of a series of basins (Selennyakh, Kyrin,Lower Moma,Upper Moma,etc.) filled with up to one km thick and bounded by the Chersky Range (up to 3100 m high) on the southwest and the Moma Range (up to 2400 m high) on the northeast. Northeast of the Moma Range is the Indigirka-Zyryanka foreland basin, composed of thick, up to 2.5 km, Eocene, Oligocene, and Miocene coal-bearing sequences, while on the southwestern side of the Chersky Range there are a number of piedmont basins (Tuostakh, Upper Adycha, Derbeke, etc.) containing up to several hundred meters of Miocene and Oligocene coal-bearing deposits.

Despite considerable study over the past half-century, there is considerable debate over the origin, present-day tectonics, and evolution of the Moma rift system. The Cenozoic deposits of the basins generally become younger from northwest to southeast with the exception of the Seimchan-Buyunda basin. In the northeast, fan-shaped coal-bearing basins (e.g., Nenneli, Olzhoi, Selennyakh, Uyandina, Tommot, and others) are filled with Miocene to Pliocene deposits, while basins in the southeast (e.g., Taskan) are filled with Neogene sediments. The Seimchan-Buyunda basin, however, has sediments of Oligocene age.

The Moma rift system is reflected a major step in the gravity field, presumably separating denser rocks of the Kolyma-Omolon superterrain from somewhat less dense rocks of the Verkhoyansk fold belt (margin of the North Asian Craton). Analysis of travel-times of Pn and Pg waves from local earthquakes indicates an area of thinned crust (30-35 km) southwest of the Moma rift system, extending as a "tongue" from the Lena River delta and the Laptev Sea to the upper part of the Kolyma River, as compared to 40-45 km in the surrounding areas. This region of thinned crust also coincides with a region of high heat flow values measured in boreholes of the Chersky Range (up to 88 mW/m2). Hot springs with temperatures up to +20°C are found within the Moma and Selnnyakh basins proper.The crustal inhomogeneity is also reflected in the upper mantle as indicated by a 40° rotation of the Rayleigh wave polarization angle from teleseisms recorded at Tiksi that cross the Moma rift system as opposed to those that do not.

Cenozoic volcanism, chemically similar to basalts and rhyolites from rift zones elsewhere is found in the Moma rift proper. Balagan-Tas is a basaltic cinder cone which has been dated at 286,000 years based on Ar-Ar dating, while Uraga-Khaya is an undated, presumed Quaternary, rhyolitic dome. All these factors indicate that the Moma rift system originated as a continental rift, probably as an extension of the Arctic (Gakkel) Mid-Ocean Ridge.

At the present, however, compressional conditions prevail within the Moma rift zone. Seismicity is generally absent from the rift basins proper or their margins; most seismicity is concentrated to the southwest of the Moma rift basins along major strike-slip fault systems. Focal mechanisms of the largest earthquakes in the Chersky Range also all show transpression. Field mapping indicates that the majority of the faults mapped in the field are strike-slip, thrust and reverse faults (86%) with only a small number of normal faults (14%) and that the Cenozoic deposits within the Moma rift are intensely folded. Re-leveling surveys conducted along the Indigirka River, which cuts across the Moma rift system, reveal a moderate rate of presnt-day vertical uplift (up to +4 mm/yr).

Thus, the Moma rift system is no longer acting as a rift, but is undergoing transpression. This conclusion is also supported by recent plate motion calculations based on GPS and VLBI data, as well as slip-vectors of earthquakes, which indicates that the Euler pole between North America and Eurasia is located around 68-70°N, near the coast of the Laptev Sea. This places the Moma rift system in a zone of convergence between North America and Eurasia; this geometry also supports the extrusion of the Okhotsk Sea plate.

Poles of rotation calculated earlier using magnetic lineation and fracture zone data from the North Atlantic yielded poles further south, about 62°N. This, combined with other evidence for extension in northeast Russia in the Oligocene and the sedimentary record of the basins, supports the origin of the Moma rift system as an extension of the Arctic Mid-Ocean Ridge in the Oligocene and continuing through about Pliocene time, although the complete lack of any evidence of volcanism in the rifts in this time period is mystifying. Sometime in the Quaternary, the pole of rotation shifted north, placing the Moma rift system into compression. The young age for Balagan-Tas would suggest that the change occurred in the not too distant past.

Thus, the Moma rift system probably originated as an extension of the Arctic (Gakkel) Mid-Ocean Ridge into the continent in the Early Cenozoic. hi the Quaternary, movement of the Euler pole between North America and Eurasia resulted in the region being placed under compression with the development (or reactivation) of major strike-slip fault systems and the compression of the former rift basins.