The Krusenstern Fault, NW Pacific: A Reactivated Cretaceous Transform Fault?

Ralf Freitag[1*], Christoph Gaedicke[1], Nikolay Tsukanov[2], Udo Barckhausen[1], Dieter Franke[1], Ingo Heyde[1], Stefan Ladage[1], Rüdiger Lutz[1], Michael Schnabel[1]

[1] Federal Institute for Geosciences and Natural Resources (BGR), Geozentrum Hannover, Stilleweg 2, 30655 Hannover, Germany; [*]corresponding author: ralf.freitag@bgr.de

[2] P.P. Shirshov Institute of Oceanology, 36, Nahimovski prospect, Moscow, Russia, 117997

Since Lower Cretaceous times, the Pacific Plate converges against the active margin of Kamchatka where it is subducting along the Kuril-Kamchatka trench. During subduction, the upper plate is strongly deformed by shortening and exhumation. Since the Upper Cretaceous, numerous allochthonous terranes were accreted to Kamchatka as part of the Eurasian Plate. At latest Kronotsky-Shipunsky terrane, an island arc of Lower Cretaceous age accreted in the Upper Miocene about 9 Ma ago. Recently, the Meiji-Rise, the northwestern most part of the Emperor Seamount Chain approach the subduction zone. The Meiji-Rise is Upper Cretaceous in age (81-85 Ma) and is elevated about 2500 m above the surrounding seafloor. Meiji is bordered by a system of dextral strike-slip faults of the Aleutian trench in the NE and by a former transform fault in the SW: the Krusenstern Fault.

The Krusenstern Fault was crossed several times during the RV Sonne cruise SO201-1a and was mapped with geophysical methods. It comprises only minor asymmetries and vertical displacement in the SE and is covered completely by sediments. The displacement and morphological expression of the fault increase rapidly towards the NW. In profile BGR09-107, the SW shoulder of the asymmetric transform fault is already about 1000 m above the surrounding seafloor. In this profile, a relay ramp was mapped pointing to a former dextral plate movement along the fault.

Further in the NW (profile BGR09-109), the displacement increases rapidly while the rough morphology is covered by young deep sea sediments. On the northwestern most profile, the recent activity of the Krusenstern Fault is proofed by echo sounder data: The surface sediments are shifted about 35 m and from MCS it is visible that it is a deep-seated crustal fault. The Krusenstern fault is a crustal normal fault dipping towards NE, which means the NE area of the Meiji Seamount is structural lower. It is not clear from our data wether there is a strike slip component along the fault.

Because no magnetic anomalies are detectable on the oceanic crust, one can only speculate about the age of the Krusenstern Fault. The acute angle of the fault and the longitudinal shape of the Meiji seamount make a synchronous evolution unlikely. The fact, that the fault seems to be covered by another seamount south of Tenji points to a pre-Emperor age. Some authors interpret the fault as a transform fault of the mid-ocean ridge between the Pacific Plate and the Kula Plate during the Cretaceous Long Normal Superchron.

The reactivation of the Krusenstern Fault may be the result of the subduction and accretion of the Meiji seamount at the Kamchatka margin. The Meiji Seamount is elevated about 2500 m relative to the surrounding seafloor, the crust is much thicker. As the linear extension of the trench does not change, this area must subducting faster in the north of Krusenstern Fault, where the Meiji Seamount is located. The Krusenstern Fault is compensating this different vertical movement in the vicinity of the trench. The sharp bend of the magmatic arc onshore Kamchatka lies in the direct continuation of the Krusenstern Fault. For larger earthquakes, the Krusenstern Fault may act as a segment boundary.