

Structure and metamorphism of a subduction mélange (Sistan, Eastern Iran): a close-up on subduction channel processes

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Suture zones preserve metamorphosed relicts of subducted ocean floor later exhumed along the plate interface and provide critical insights on subduction zone processes.

The suture zone of Sistan (Eastern Iran) formed as a result of the closure of a branch of the Neotethys separating the Lut and the Afghan continental blocks and offers privileged outcropping conditions. High pressure rocks are found in the inner part of the suture zone, called “the Ratuk complex”. This study focuses on the northern exposures around Gazik and compares them with the previously studied outcrops of Sulabest.

Field study and mapping allows the distinction of two kinds of subduction-related tectonic mélanges, a flysch-matrix mélange and a serpentinite-matrix mélange. The flysch-matrix mélange includes barely metamorphosed radiolarites and basalts of maximum greenschist-facies grade. This mélange reached a maximum temperature of 340°C.

The serpentinite-matrix mélange includes blocks of various grades and lithologies: mafic eclogites, epidote-amphibolite rocks, blue-amphibole-bearing metacherts, and greenschist-facies metabasalts. Eclogites reached peak pressure conditions at 520°C and 2.2 GPa and a peak temperature at 630°C and 1.2 GPa. Estimation of PT conditions for the other rocks are less-well constrained but suggest that they originate from at least three different depth zones in the subduction.

Very similar Ar-Ar ages of 87.5 ± 3 Ma are obtained for phengite and amphibole from fourteen eclogite and epidote-amphibolite samples from the ~70 km long serpentinite-matrix mélange. Ages in Sulabest are usually older than in Gazik, but there is little age difference between the various kinds of rocks.

These results (radiometric ages, observed structures and rock types) allow to place constraints on subduction zone dynamics, particularly on detachment and exhumation mechanisms of slab-derived rocks.