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Geochemistry and metamorphism of the Paleozoic metasedimentary basement of the Sierra Madre Oriental, NE Mexico. Possible paths from their depositional environment?

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We present depositional conditions and possible protholits for Late Paleozoic metasediment in Mexico that were related to the Laurentia-Gondwana collision in Carboniferous time, during Pangea amalgamation. The study aims to reconstruct the depositional and metamorphic evolution of the Granjeno Schist in northeastern Mexico to get a better control on the timing of subduction and collision processes involving the two supercontinents.
Remnants of the Mexican Paleozoic continental configuration are present in the Granjeno Schist, the metamorphic basement of the Sierra Madre Oriental in northeastern Mexico. We apply field mapping, petrographic investigations, whole-rock and mineral chemical analysis, as well as U-Pb zircon dating of both metasedimentary and metavolcanic rocks.
Field work and petrographic analysis reveal that the Granjeno Schist comprises intercalations of metamorphic rocks with both sedimentary (psammite, pelite, turbidite, conglomerate, black shale) and volcanic (tuff, lava flows, pillow lava and ultramafic bodies) protoliths. The chlorite geothermometer and the presence of phengite in the metasedimentary units as well as U-Pb zircon ages on metapsammite indicate that the Granjeno Schist was metamorphosed under sub-greenschist to greenschist facies with temperatures ranging from 250-345°C during the Carboniferous time (330±30 Ma).
The geochemical composition of the metasedimentary rocks is in accordance with iron shale, wacke and quartz arenite protoliths. Some of the variations can be explained by the grain sizes (e. g., 69-74% and 78-96% SiO_2 and 10-15% and 3-9% $Al2O_3$ in metapelite and metapsammite, respectively). Our data suggest that the Granjeno Schist metasedimentary units represent a wide variety of clastic sediments derived from mixed felsic basic sources compositions (e. g., Ti/Nb 200-400). Furthermore, the trace element characteristics point to a continental island arc or active continental margin setting due to e. g., Th/Sc and Zr/Sc ratios of 5-8 and 0.3-0.5, respectively, both for metapelite and metapsammite.
The metavolcanic rocks are associated with ocean-island basalt (OIB) or mid-ocean ridge basalts (MORB) due to the immobile trace element ratios Zr/Nb and Y/Nb in the ranges 4.91-8.06 and 0.74-1 for the IOB and >9.2 and >1.25 for the MORB, respectively.
Detrital zircon ages for three metapsammites reveal that the major sources mainly are Grenvillian (1250-920 Ma) rocks. Such rocks can be found in the ca. 1 Ga Oaxaquia Complex in NE Mexico (Novillo Gneiss). Hence, short transport can be assumed. Maximum depositional ages are Neoproterozoic, Silurian and Devonian. They indicate that the volcanosedimentary deposition probably took place during Devonian time.
Based on our results we suggest a plate-tectonic frame for Oaxaquia which is a modification of accepted models. Most models suggest that Oaxaquia was situated between Laurentia and Gondwana during collision in Carboniferous time. The zircon data indicate that the Granjeno Schist was deposited before the collision of Laurentia and Gondwana. The presence of ocean basalt floor, lava flows and serpentinite lenses intercalated with tuff and active continental margin sedimentary rocks necessitates a near-continental environment, such as a back-arc basin. Hence, we present the first evidence of a subduction zone predating the collision of Laurentia and Gondwana.