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GEOCHEMISTRY AND METAMORPHISM OF THE PALEOZOIC METAMORPHIC BASEMENT OF THE SIERRA MADRE ORIENTAL, NE MEXICO: WAS NORTHEASTERN MEXICO A PART OF PANGAEA?

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Late Paleozoic metamorphic rocks from the basement of the Sierra Madre Oriental are related to the Laurentia-Gondwana collision in Carboniferous time, during Pangaea amalgamation. Remnants of the Mexican Paleozoic continental configuration are present in the Granjeno Schist, the metamorphic basement of the Sierra Madre Oriental in northeastern Mexico (Steward *et al.*, 1999; Keppie & Ramos, 1999; Nance *et al.*, 2010). Field work and petrographic analysis reveal that the Granjeno Schist comprises metamorphic rocks with both sedimentary (psammite, pelite, turbidite, conglomerate, black shale) and igneous (tuff, lava flows, pillow lava and ultramafic bodies) protoliths (Carrillo-Bravo, 1961; De Cserna & Ortega-Gutiérrez, 1978; Ramírez-Ramírez, 1992; Dowe *et al.*, 2005; Torres-Sánchez, 2010). The chlorite geothermometer as well as $^{40}Ar/^{39}Ar$ ages on metavolcanic rocks indicate that the Granjeno Schist was metamorphosed under sub-greenschist to greenschist facies (250-345°C) during Carboniferous time (330±30 Ma).

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.

The geochemistry of the metavolcanic rocks indicates an origin in different tectonic environments: mid-ocean ridge and ocean-island. High ratios of Hf/Th and Th/Nb (4.4–14 and 0.08–0.15), low ratios of LaN/YbN and LaN/SmN (0.74–1.7 and 0.60–1.4) and depleted LREE patterns in metabasalt display mid-ocean ridge characteristics. In contrast, the pattern of trace-element ratios and REEs in metabasalt and metapillow lava 60 km to the west indicates a magma source with ocean-island basalt characteristics (Torres-Sánchez *et al.*, 2015).

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% Al_2O_3 in metapelite and metapsammite, respectively). ∑REE abundances are highly variable in the metasediments (13 to 152 ppm) and chondrite-normalized REE patterns are more fractionated than in the metavolcanic rocks (e.g., LaN/YbN 2.66–16.46) with negative europium anomalies of Eu/Eu*0.67. The metasedimentary units represent a wide variety of clastic sediments derived from mixed felsic and basic source compositions (e. g., Ti/Nb 200-400).

The trace element Th/Sc and Zr/Sc ratios of 5-8 and 0.3-0.5 point to an active continental margin setting. Values ranges from 60-74 for the Chemical Index of Alteration and Plagioclase Index of Alteration (>75) in the metasediments, indicate intermediate chemical weathering in their source area or during transportation and that recycling processes might have been significant. The chemical composition of detritic tourmaline, rutile, allanite,

sillimanite, tremolite, crossite, zoisite and detrital zircon ages for metapsammites reveal that the major sources are Grenvillian (1250-920 Ma) rocks. These 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 (Barboza-Gudiño *et al.*, 2011). They indicate that the volcanosedimentary deposition probably took place during Devonian time.

Based on our results we suggest a modified plate-tectonic frame for Oaxaquia. 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 this collision. The presence of ocean basalt floor and serpentinite lenses intercalated with tuff and active continental margin sedimentary rocks necessitates a near-continental environment. Our new tectonic model, which differs from earlier models, suggests that the origin of the Granjeno Schist is related to a subduction zone located at the western margin of Pangaea, active after Laurentia–Gondwana collision.

REFERENCES

Barboza-Gudiño, J.R., Ramírez-Fernández, J.A., Torres-Sánchez, S.A., Valencia, V.A. 2011. Geocronología de circones detríticos de diferentes localidades del Esquisto Granjeno en el noreste de México. *Boletín de la Sociedad Geológica Mexicana* **63**, 2, 201-216.

Carrillo-Bravo, J. 1961. Geología del Anticlinorio Huizachal-Peregrina al NW de Ciudad Victoria, Tamaulipas. *Boletín de la Asociación Mexicana de Geólogos Petroleros* **13**, 1-2, 1-98.

De Cserna, Z., Ortega-Gutiérrez, F. 1978. Reinterpretation of isotopic age data from the Granjeno Schist, Ciudad Victoria, Tamaulipas. *Revista Mexicana de Geociencias de la Universidad Nacional Autónoma de México* **2**, 31-36.

Dowe, D. S., Nance, R. D., Keppie, J. D., Cameron, K. L., Ortega-Rivera, A., Ortega-Gutiérrez, F., Lee, J.W.K. 2005. Deformational history of the Granjeno Schist, Ciudad Victoria, Mexico: Constraints on the closure of the Rheic Ocean? *International Geology Review* **47**, 9, 920-937.

Keppie, J.D., Ramos, V.A.R. 1999. Odyssey of terranes in the Iapetus and Rheic oceans during the Precambrian. In: *Laurentia Gondwana Connections before Pangea*, Ramos, V.A., Keppie, J.D. (eds.). *Geological Society of America Special Paper* 336, 267-275.

Nance, R.D., Gutiérrez-Alonso, G., Keppie, J.D., Linnemann, U., Murphy, J.B., Quesada, C., Strachan, R.A., Woodcock, N. 2010. Evolution of the Rheic Ocean. *Gondwana Research* 17, 2–3, 194–222.

Ramírez–Ramírez, C. 1992. *Pre-Mesozoic geology of Huizachal–Peregrina anticlinorium, Ciudad Victoria, Tamaulipas, and adjacent parts of eastern México.* Ph.D Thesis, University of Texas, Austin, 318.

Stewart, J.H., Blodgett, R.B., Boucot, A.J., Carter, J.L., López, R. 1999. Exotic Paleozoic strata of Gondwanan provenance near Ciudad Victoria, Tamaulipas, México. *Geological Society of America Special Papers* 336, 227-252.

Torres-Sánchez, S.A. 2010. *Petrología e Interpretación Geodinámica del Esquisto Granjeno en el Cañón de Caballeros, Anticlinorio Huizachal-Peregrina, NE de México.* B.Sc. Thesis, Universidad Autónoma de Nuevo León, 186.

Torres Sánchez, S.A., Augustsson, C., Barboza Gudiño, J. R., Jenchen, U., Ramírez Fernández, J. A., Abratis, M., Scherstén, A. 2015. Magmatic source and metamorphic grade of metavolcanic rocks from the Granjeno Schist: was northeastern Mexico a part of Pangaea? *Geological Journal*, DOI: 10.1002/gj.2702