Petrology and thermochronology of the Juan Fernandez Ridge (Nazca Plate)

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The Juan Fernandez Ridge on the oceanic Nazca plate is thought to be a classic hot spot trail because of the apparent age progression. However, geochronological data is still scarce and only a few anchor points are available to support this hypothesis. A 40Ar/39Ar total fusion age of ca. 9 Ma was previously obtained for the OHiggins seamount (115 km from the Chile-Peru trench) as well as K-Ar ages of ca. 3-4 Ma in Robinson Crusoe island (580 km from the trench) and ca. 1 Ma in Alejandro Selkirk (180 km further west). Taken together, they indicate a westward displacement of Nazcla plate at ca. 6-8 cm/yr, which is in good agreement with plate models and modern GPS data. On the other hand, new 40Ar/39Ar and geological reconnaissance suggest a post-shield stage in Robinson Crusoe, which is ca. 3 Ma younger than the main shield stage.

Petrological evidence also supports a typical hotspot evolutionary pattern. In fact, the partially altered older sequence in Robinson Crusoe island is tholeiitic (Ba/Yb=64.79; La/Yb=10.70; Ba/Zr=0.76; Nb/Zr=0.16). The shield stage (ca. 1-3 Ma) is transitional from tholeiitic to alkaline (Ba/Yb=107.42; La/Yb=13.69; Ba/Zr=1.07; Nb/Zr=0.16) and the younger post-shield stage (ca. 1 Ma) is mostly alkaline (Ba/Yb=236.58; La/Yb=22.32; Ba/Zr=2.26; Nb/Zr=0.26).

A fixed deep-mantle plume origin for Pacific hot spots has been widely debated and concurrent phenomena arise as a possible explanation for non-linear age progressions and/or long-lived volcanic activity. In fact, intraplate regional tectonics, plume displacement, and mantle heterogeneities could be the main factor of the ridge architecture or the mask for a first-order linear trend. An ongoing mapping and dating effort is aimed to understand the evolution of the Juan Fernandez Ridge.

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