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Unraveling the origin and magmatic evolution of the rejuvenated volcanism in the Juan Fernández Ridge, SE Pacific

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The Juan Fernandez Ridge (JFR) is a ca. 800 km long off-ridge volcanic chain built above the Nazca plate, SE Pacific, formed by partial melting of a heterogeneous mantle plume. After the voluminous development of shield volcanoes as a result of the passage of the oceanic lithosphere over the plume, at least three volcanic complexes of the JFR (from E to W: O'Higgins Guyot, Beta Seamount and Robinson Crusoe Island) developed a late stage of magmatism, known in this context as rejuvenated volcanism and attributed worldwide to plume melting or interaction with a metasomatized lithosphere.

Despite their differences in age (up to ~8.5 Ma) and geographic distance (up to ~470 km), magmas erupted during the rejuvenated stage at JFR show remarkable compositional similarities. Exposed lavas consist of basanites and picrobasalts with olivine, diopside and occasional ultramafic xenoliths. They are enriched in incompatible elements when compared to the shield stage, especially in LILE and LREE. Compositional variations suggest a magmatic evolution controlled by fractional crystallization and assimilation of MORB-like rocks in reservoirs located at different depths, although some MgO-rich magmas could ascend relatively directly.

The Sr-Nd-Pb isotopic signature is close to the FOZO source, like the shield, although slightly depleted (less radiogenic in $^{87}Sr/^{86}Sr$, $^{206}Pb/^{204}Pb$, $^{207}Pb/^{204}Pb$ and more radiogenic in $^{143}Nd/^{144}Nd$) with internal variations subparallel to the EMI-HIMU trend. An exception is $^{208}Pb/^{204}Pb$, which is slightly more radiogenic at a given $^{206}Pb/^{204}Pb$, reaching the highest values in the SE Pacific (only comparable to the San Felix/San Ambrosio Islands, located ~800 km to the N). The isotopic data are not located on the mixing line between the JFR shield and MORB (either East Pacific Rise or Chile Rise) but are compatible with the assimilation of MORB-like lithosphere.

The latter complicates the genetic explanation of the rejuvenated magmas in JFR. We favor an origin for the late-stage magmas from a heterogeneous mantle plume exposed to a low degree of partial melting, with minor compositional changes over time and assimilation of metasomatized lithosphere controlled by tectonic processes.