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Magmatic and tectonic processes recorded by mantle rocks of the Taitao ophiolite (6 Myr), southern Chile

MANUEL E SCHILLING[1], GAËLLE PLISSART[1], NORIKATSU AKIZAWA[2], KUAN-YU LIN[3], ALEXANDRE CORGNE[1], MAITE ALVEAR[1], EMILIO J GONZÁLEZ[1], CATALINA MARÍN[1], RICHARD J. WALKER[4], RYO ANMA[5], JESSICA M WARREN[3], AKIRA ISHIKAWA[6], CÉCILE PRIGENT[7], VICTORIA E GONZÁLEZ[1], ANA RIVERA[1], FELIPE A MARTÍNEZ[1], NATALIA F DONOSO[1] AND JOSE MARÍA GONZÁLEZ-JIMÉNEZ[8]

[1]Universidad Austral de Chile
[2]The University of Tokyo
[3]University of Delaware
[4]University of Maryland
[5]Tokushima University
[6]Tokyo Institute of Technology
[7]Institut de Physique du Globe de Paris
[8]Andalusian Institute of Earth Sciences, Spanish National Research Council (IAT-CSIC)

Presenting Author: manuel.schilling@uach.cl

The Taitao ophiolite is located ~40 km southeast of the Chile triple junction, where the active Chile Ridge is being subducted under the South American plate. It was formed around 6 Myr ago in the southeast Pacific Ocean and emplaced onto the continent shortly after. At the same time, subduction of the adjacent and hot oceanic crust caused intense magmatic activity with the formation of unusual granitoid plutons, volcano-clastic units, and an active hydrothermal anomaly in the continental forearc region.

This study provides new field observations of the mantle section of the Taitao ophiolite, together with petrographic characterization, mineral compositions, and whole-rock chemistry including major and trace elements (lithophile and highly siderophile) and Os isotopes. The main lithology present in the mantle unit is harzburgite, often cut by late pegmatitic gabbro and diabase dykes. The selected areas of interest described and sampled at the meter to submeter scale include: 1) centimetric dunite and pyroxenite lenses hosted in the harzburgitic domains; 2) a layered section associated with the mantle-crust transition zone (Moho) composed of layers of dunite (with and without disseminated chromites), pyroxenites, lherzolites, and harzburgites; 3) strongly mylonitized ultramafic and mafic rocks at the base of the ophiolite in contact with the Cabo Raper pluton (3.9 Myr); and 4) individual lithologies including the first ever reported chromitite lens for the Taitao ophiolite, and diverse clinopyroxenites and dunites with variable amounts of disseminated chromite and sulfides. Dunite lenses normally have more depleted chemical but similar Os isotopic compositions than their host harzburgites consistent with partial melting and/or melt-rock interaction at low melt/rock ratios. Conversely, chromitite and the clinopyroxenite and dunite layers have a wider range of chemical and Os isotopic compositions, reflecting more complex processes of melt transport and higher melt/rock ratios, particularly near the Moho. The ultramafic mylonites were formed by ductile deformation at mantle temperatures, possibly within the dry roots of a fault related to the emplacement of the Taitao ophiolite. U-Pb zircon dating of a granitic lens included and deformed within the mylonitic unit provides a minimum age for the obduction process of 4.9 Myr.