Crust formation in the New Hebrides Arc

KARSTEN M. HAASE[1], SELMA M. LIMA[1], MICHAEL U. GRESS[2] AND CHRISTOPH BEIER[1]

[1]Geozentrum Nordbayern (Germany) karsten.haase@fau.de; selma.m.lima@fau.de; christoph.beier@fau.de
[2]Vrije Universiteit (Netherlands) m.u.gress@vu.nl

Subduction zone magmatism is regarded as the main mechanism by which new continental crust is created. Exposed profiles of paleo-arc crusts (e.g., the Talkeetna, Bonanza, and Kohistan sections) have been studied in much detail and variable mechanisms for their evolution from a primitive basaltic to a bulk andesitic composition, such as remelting of the lower crust, extensive fractionation and delamination of the residual products, were proposed (e.g. DeBari and Greene, 2011). However, little is known about the deeper crust in active oceanic island arcs, although it is here where the early stages of continental crust formation occur.

The New Hebrides Island Arc is a young, active subduction zone in the SW Pacific. Its southern back-arc, known as the Coriolis Troughs, was the focus of RV Sonne cruise SO-229 in 2013. During this expedition, two sections of the rifted island-arc crust were sampled, one at the western side of the Nifonea Ridge (SE Vate Trough) and the other at the eastern side of the southernmost Futuna Trough. At Nifonea 21 samples (mostly tholeiitic basalts) were collected from 1962–1506 m water depth and at Vate 36 samples (mostly basaltic andesites) were collected from 3271–1008 m water depth. The phenocrystic association in the Vate crust is Pl > Ol > Cpx > Sp, whereas, in the Futuna lavas, Ol is absent and Opx crystallizes, indicating relative higher pressures of crystallization in Futuna relative to Nifonea. Major and trace elements vary substantially in the individual profiles without a clear trend with decreasing depth, but the uppermost lavas generally are more homogenous in both profiles. Isotopic compositions and trace element ratios generally reveal a more depleted nature for the Vate crust where most of the lavas have $^{87}Sr/^{86}Sr$ = 0.70245–0.70409, εNd = 9.2–10.0, and Nb/Y < 0.15. The Futuna crust is typically characterized by $^{87}Sr/^{86}Sr$ = 0.70393–0.70401, εNd = 5.8–6.3, and Nb/Y > 0.15. This implies significant changes in source fertility. Opening of the Coriolis Troughs progressed from south to north, which is consistent with a time-integrated depletion of the mantle underneath. Precise Ar-Ar ages will shed more light on the age and duration of processes leading to the formation of both crusts and a better understanding of the evolution of newly formed island arc crust during its early stages.