Geology of the North Fiji Basin Triple Junction: A possible modern analog of late Archean mafic magmatism and VMS formation

M Besaw*[1], M Hannington[1,3], A Baxter[1], M Stewart[1,2], S Petersen[3], A Krätschell[3]
[1]Department of Earth and Environmental Sciences, University of Ottawa, Ottawa, Ontario, Canada
[2]Department of Earth and Environmental Sciences, Mount Royal University, Calgary, Alberta, Canada
[3]GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Schleswig-Holstein, Germany
*mbesa083@uottawa.ca

The North Fiji Basin Triple Junction (NFBTJ) is located at the center of the world's largest and most evolved backarc basin. The NFBTJ is a ridge-ridge-ridge (RRR)-type triple junction where the New Hebrides, Balmoral Reef and Conway Reef microplates meet. NFBTJ exists in its current configuration since 1 Ma. A compilation of marine geophysical data (hydroacoustics, magnetics, and gravity) was used to construct the first comprehensive geological map of the NFBTJ at 1:250,000 and investigates the relationship between the mapped structure, magmatism and hydrothermal systems. Because the triple junction has acted as a locus for high-heat flow, faulting, and crustal-scale permeability for more than 3 million years, there is a close link to the evolution of regional hydrothermal activity. However, hydrothermal vents have only been reported from the southern arm of the NFBTJ. Here, we compare mapped formations (i.e., the sequence of depositional events, the composition of the substrate, and its deformation and structures) to the location of known hydrothermal vents and assess the geological, geodynamic, and structural differences between the arms of the triple junction to identify optimal conditions promoting hydrothermal venting. The northwest arm (N160) is a broad 30-km wide zone of normal faulting with volumetrically minor older eruptions along the axial rift graben. The northeast arm (N55) is a 30-km wide, short 57-km long rift graben that terminates at a strike-slip zone. The southern arm (N120) is a well-developed spreading ridge and contains most of the central volcanic complex (27-km long, 15-km wide, and 0.4-km max-height). Numerous hydrothermal systems (White Lady, StarmerII, Pere Lachasise and Sonne99) and their associated sulphide occurrences are located within the N120 arm, adjacent to the central volcanic complex. Between 3 and 1 Ma, the N55 graben evolved from a strike-slip fault that intersected the N160 and N120 arms junction, allowing for high permeability through faults and magmatic influences from N120. N55 arm is now developing a spreading center similar to the N120 arm, with increasing magmatic input in response to readjustment due to the North Fiji Fracture Zone. Thus, N55 is likely to become a new center of hydrothermal activity as the microplates adjust. The N160 arm shows no evidence of active magmatism, and all extension is interpreted as tectonically controlled. This is Metal Earth publication number MERC-ME-2021-021.