Tectonic activity of the northern and southern plate boundaries of the Niuafo'ou microplate, Lau Basin, southwest Pacific Ocean

Anouk Beniest1,2, Michael Schnabel3, Anke Dannowski1, Florian Schmid1, Anna Jegen1, and Heidrun Kopp1
1GEOMAR, Helmholtz Centre for Ocean Research Kiel, Kiel, Germany
2Vrije Universiteit Amsterdam, Amsterdam, The Netherlands
3BGR, Institute for Geosciences and Natural Resources, Hannover, Germany

The northern Lau Basin in the southwest Pacific Ocean is one of the fastest opening back-arc basins on Earth, resulting in a mosaic of microplates, including the Niuafo'ou and Tongan microplates. The Fonualei Rift and Spreading Center (FRSC) is the eastern plate boundary that separates the Niuafo'ou from the Tongan microplate. The northern part of the FRSC is actively spreading, whereas the southern part is rifting. What is unclear, however, is how extension of the Lau Basin is accommodated north and south of the FRSC.

We present the results of six Multi-Channel Seismic profiles acquired during the ARCHIMEDES-I expedition and show an analogue lithosphere-scale model example of our proposed tectonic evolution. Profiles P1 (oriented NW-SE) and P2 (oriented W-E) cover the Mangatolu Triple Junction (MTJ) and the northern part of the FRSC. P3 and P4 (both oriented W-E) cover the southern Niuafo'ou microplate. P5 and P6 (both oriented W-E) cover the area south of the FRSC.

The northern profiles (P1 and P2) reveal a thick package of sediment towards the east, covering a heavily faulted basement over a wide area. Some indication for intrusive material is observed closer to the volcanic arc, but also further towards the western end of P2. Faults cross-cutting the basement but that do not reach the surface are considered inactive today. Faults reach the surface close to the MTJ and the northern tip of the FRSC and are considered active today. This leads to the interpretation that an earlier rift phase accommodated extension in a wide rift tectonic setting, whereas today, the extension is accommodated in a narrow rift or spreading tectonic setting. We will show an analogue model example that demonstrates this wide-to-narrow extensional tectonic evolution.

The profiles that cover the southern extent of the FRSC (P3, P4, P5 and P6), show that active faulting occurs towards the west, close to the Central Lau Spreading Center. Hidden faults that have deformed the basement, but do not affect the surface today anymore are observed in the abyssal parts of P3, P4, P5 and P6. Active faults that reach the surface are also observed towards the east. Recent volcanism is observed, both in the form of intrusive bodies, i.e. sills, as well as volcanoes that pierce through the stratigraphy. The observations lead to the conclusion that south of the FRSC an earlier (wide) rift system affected a larger area in the current abyssal parts of the
profiles, whereas extension is currently accommodated through spreading in the CLSC, west of the southern tip of the FRSC.