Intrabasinal sediments and tectonostratigraphy of the Lau Basin: Assessing linear vs. diachronous models for the opening of the Lau back-arc

J Kehew*[1], M Hannington[1], A Baxter[1], M Riedel[2], S Petersen[2],
[1]Department of Earth and Environmental Science, University of Ottawa, Ottawa, Ontario, Canada
[2]GEOMAR Helmholtz Centre for Ocean Research Kiel, Kiel, Germany
*jkehe018@uottawa.ca

The Lau Basin in the southwest Pacific Ocean is a typical example of a back-arc basin that is actively extending due to trench rollback and microplate rotation. Extension is partially accommodated by the opening of many small volcano-sedimentary basins, individually 2 - 40 km long and 1 - 45 km wide but collectively spanning the entire 400 km width of the Lau back-arc. However, the nature, timing and controls of sub-basin opening are not well understood. Here, we investigate the sedimentary and structural history of sub-basin development in a 290-km long, east-west transect at 17°20'S. To analyze the sediment stratigraphy in each sub-basin, we use high-resolution, 0.5–6.0-kHz sub-bottom profiles collected with the 'ATLAS Parasound' system during mapping aboard R/V Sonne (SO267). Reflection seismics from the same cruise reveal the large basin-bounding structures, such as regional faults at scales of kilometers, while the Parasound data reveals sedimentary structures and textures, in addition to smaller, localized faults and buried ridges at a resolution of a few meters. The structures, sedimentary units and volcanic features were analyzed in 24 sub-basins along the 290-km long transect. The individual basins have an average width of 6 km and an average sediment thickness of 50 m, comprising mostly volcaniclastic material and minor pelagic sediment. The sub-basins were divided into five groups based on sedimentary composition and structures, and the type of underlying crust, each representative of a different phase of basin opening. Normal faulting dominates, with evidence that some might have provided sub-seafloor pathways for magma or hydrothermal fluids. The results show that extension did not occur uniformly from the center of the basin; rather, the locus of extension jumped to different parts of the basin over time. We propose a model of mainly diachronous opening of the basin and asymmetric versus linear extension, which has important implications for the development of crustal permeability and magmatism during back-arc spreading. The ability to recognize this extensional style has important implications for understanding crustal permeability and magmatism in ancient greenstone belts, including distributed versus focused extension and consequences for the location of ore deposits. This is Metal Earth Contribution No. MERC-ME-2021-023.