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## 1:1 Million Map of the Lau Basin: A New Framework for Geologic Mapping of the Seafloor

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Geologic maps are critical to our understanding of Earth evolution and processes, including plate tectonics, crustal growth, basin evolution, and the formation of mineral and energy resources. The geomorphology of the global oceans has been determined from satellite altimetry and derived gravity models, but less than 5% of the seafloor has been explored in detail, leaving the vast majority unmapped and its geologic makeup poorly understood. Large-scale geologic maps have so far been limited to the 1:35-million-scale compilation of the Commission of the Geological Map of the World (2014) and the 1:17-million-scale compilation of the Circum-Pacific Council for Energy and Resources (2013). At these scales, the smallest geologic features depicted are on the order of 100 km. More detailed geologic maps of the ocean floor have been created in areas where local high-resolution multibeam bathymetry, acoustic backscatter, and direct seafloor observations exist. However, most of these maps are of limited areal extent and rarely correlate lithostratigraphic units regionally or basin-wide. To illustrate how this can be achieved for a larger area, we have prepared the first geologic map of the Lau Basin at 1:1 million in a single sheet and correlated assemblage- and formation-level geologic units across the entire basin.

The Lau Basin is characterized by some of the fastest growing crust on Earth, associated with high heat flow and prolific magmatic and hydrothermal activity, and it is the type locality for intraoceanic back-arc basin formation. It has been the target of more than 50 research cruises since 1970, most collecting multibeam bathymetry and half collecting whole-rock samples, making it one of the best-studied regions of the deep ocean. The available geophysical and sampling data provide the necessary criteria for recognition of geologic formations and are the basis of an internally consistent geologil legend. The map covers more than 1,000,000 km$^2$ of the arc-back-arc system, subdivided into nine assemblage types: active arc (6% by area), back-arc rifts and spreading centers (19%), transitional arc-back-arc crust (13%), relict arc crust (40%), forearc crust (9%), relict back-arc crust (8%), and undivided arc-back-arc assemblages (<5%), plus oceanic assemblages, intraplate volcanoes, and carbonate platforms. The distribution of these assemblages is consistent with a recent microplate breakout north of a major crustal-scale fault (Peggy Ridge) and accelerated basin opening accommodated by seven different spreading centers. These observations provide important clues to the geologic evolution and makeup of arc and back-arc crust and processes of crustal growth, including the emergence of melt and fluid pathways for magmatic-hydrothermal mineralizing systems.