

Controls on sporadic volcanic activity in a shallow marine, monogenetic basaltic complex, North Otago

Doris Maicher, Geology Department, University of Otago, P.O. Box 56, Dunedin, New Zealand

The Lookout Bluff volcanics in North Otago, New Zealand, comprise a multiple-vent complex of shallow marine tholeiitic volcanoclastic rocks, resting on fossiliferous (Kaiatan, upper Eocene) siltstones of a transgressive shelf setting (Coombs, et al., 1986). Timing of eruptive activity was sporadic, varying from contemporaneous eruptions from two vents, to activity widely spaced in time. The latter is indicated by conformably interbedded siltstones. Recommencement of volcanic activity with similar style and in close vicinity requires long-lived, but sporadic magma supply in an extensional tectonic setting.

The volcanics belong to the Eocene-Oligocene Waiareka-Deborah volcanics of the North Otago volcanic province. At Lookout Bluff, cliff exposures of vesicular-pyroclast breccias, lapillistones and tuffs show massive to well-bedded sequences. The wide variety of bedding dips is interpreted as originated from several small, monogenetic cones. Vent locations are ill-defined, but flow direction indicators and dips of beds enable the architecture of the cone field to be reconstructed. Vents are closely spaced over an area of c. 4 x 1.5 km extent, including offshore platforms with lineations of volcanic erosional remnants.

The depositional process is interpreted as fallout, modified by penecontemporaneous resedimentation processes. Characteristic sedimentary structures are normal grading and density grading, faint alignment of clasts and minor ripple and dewatering structures. The glassy, poorly sorted and low-to-moderately vesicular clasts are mostly angular with fracture-bound surfaces transecting vesicles, indicative of phreatomagmatic fragmentation.

The volumetrically small deposits, each of which accumulated within hours to days of activity contrast strongly with long periods of volcanic quiescence, during which glauconitic and non-glauconitic siltstones were deposited. Duration of breaks in volcanic activity range from 10^3 - 10^6 yrs, based on estimates of siltstone deposition rates and times required to form glauconite (Odin and Matter, 1981, Einsele, 1992). Similar fields of monogenetic eruptions are documented in oceanic rift systems, e.g. south of Iceland (Thorarinsson, et al., 1964) and Terceira rift, Azores (Machado, et al., 1962). In contrast, Lookout Bluff, at time of activity, was situated on an continental shelf, which was subsiding due to extensional movements of the Pacific and Australian plates (Field and Browne, 1989).

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D. Maicher (1998): Controls on sporadic volcanic activity in a shallow marine, monogenetic basaltic complex, North Otago. LAVA News, Geological Society of Australia, Vol 1: 9.