



Shoaling sills of a Large Igneous Province: sills and dikes at Coombs Hills, Ferrar Province, Antarctica

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Ferrar Group igneous rocks in South Victoria Land comprise extensive sills, dikes, and volcanoclastic rocks of a Large Igneous Province. In the northern part of the Coombs Hills, bodies of country-rock sandstone up to 800 m high are apparently engulfed in basaltic rocks intruded at shallow (< 1 km) depths beneath the pre-eruption surface. These large blocks are rotated 5-15°, and cut by wedge-shaped basaltic bodies extending from enclosing intrusive rocks. Nearby, bodies of basaltic pyroclastic rock, deposited at the original ground surface and locally including fossilised trees, are surrounded by intrusive rocks. Also present in the intrusive rock are large "rafts" of bedded country rock sandstone, mildly folded and cut by numerous small dikes and dikelets. We infer that these relationships developed as large sills of tholeiitic magma approached the surface in the Coombs Hills area. As country rock was buoyed upward during sill intrusion, large blocks of roof rock, extending to the pre-eruption ground surface, were broken loose and subsided into the intruding magma. Multiple injections of magma inflated the intruded sheets, which thickened until the country-rock blocks were wholly enclosed. Thinner country-rock sheets formed by injection of sills, which wedged thin layers away from thicker country-rock bodies. During this wedging process, numerous thinner dikelets injected the country rock bodies, and the country rock layers were able to semi-ductilely deform. We infer that flood-basalt eruptions here initiated when intruding sills neared the ground surface and buoyed up overlying country, which was cracked and wedged apart by sequential injections of Ferrar tholeiite magmas. The shoaling sills served as feeders to the flood basalts, either through dike swarms injected upward from shallow sills, or by disintegration of surficial rocks as the sills themselves reached very shallow levels. Large phreatomagmatic volcanoclastic deposits are closely associated, and may have developed in response to this style of shallow magma injection.