

Physical volcanological features of pillow lavas from the Palaeoproterozoic Mako Supergroup, Eastern Senegal

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The c. 2.2 Ga Mako Supergroup is found in the western part of the Kedougou-Kenieba Inlier of the Palaeoproterozoic Birimian Belt of the West African Craton, in SE Senegal. The lower part of the Mako Supergroup consists of tholeiitic pillow lavas overlying gabbros and ultramafic rocks. The pillow lavas are overlain by metacherts, shales, and carbonate rocks. They are intruded by calc-alkaline plutons and dykes, and overlain by a calc-alkaline volcanic succession. The total succession is interpreted to represent an ophiolitic oceanic crustal section (ultramafic rocks, gabbros, pillow lavas and deep sea sedimentary rocks), into which an island arc plutonic and volcanic calc-alkaline suite was emplaced.

The Mako pillow lavas were examined in outcrops along the Gambia River at Badian, near Mako, at Kérékounda, and from Sandikounda, about 150 km N of Mako. Most of the pillows have typical flattened balloon shapes, with broad convex upper surfaces, and more pointed rounded protuberances extending into the space between underlying pillows. The pillows are surrounded by prominent fine-grained (originally glassy) chilled margins, about 1-2 cm in width. In general their shapes show little external tectonic strain imposed on the pillow lavas. Some pillows are locally highly deformed, due to having been evacuated of lavas from their still molten interiors, resulting in flaccid, crumpled shapes like burst balloons, as they were plastically deformed, while still hot, under the weight of the overlying pillow lava pile. The interior of many pillows show empty irregular shaped vacuoles and lithophysae (flattened subhorizontal cavities), formed by outflow of lava after a larger proportion of cooling and crystallization of the lava had occurred. Vesicles present in pillow margins are generally very small, and show a narrow range in diameter, averaging about 3 mm. This indicates large palaeodepths, consistent with eruption in a deep-water mid-ocean ridge environment. At Badian, one pillow exterior showed 2-3 mm spaced slightly arcuate parallel grooves, extending for up to 10 cm along a whole side of the pillow- these are interpreted as extrusion-related striations produced when lava is extruded from a hackly, irregular fracture in the glassy exterior rind of a pillow with a still molten interior. Other features associated with the pillow lavas are hyaloclastic breccias- which may represent broken glassy pillow rinds (pillow block breccias), and other kinds of volcanic breccias, formed on the ocean floor. Many of these breccias are cemented with milky quartz, probably due to hydrothermal silica exhalations, which are also related to the formation of laminated banded cherts, and silica veins cementing carbonate breccias deposited above the pillow lavas. Some of the quartz veining was very early, since thin quartz veins are ptymatically folded (similar to mudcrack infills in sedimentary rocks) due to compaction of the volcanic pile- indicating they were injected into fractures while the lava was still hot. The physical volcanological features of the Mako pillow lavas indicate a dynamic sea-floor environment of deposition, with contemporaneous hydrothermal activity, very similar to mid-ocean ridge environments in modern oceans.

Keywords: lithophysae, hyaloclastites, vesicles, extrusion striations