Origin and tectonic significance of the Permo-Carboniferous clastic dykes of West Falkland-Malvinas

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Late Paleozoic glacial deposits in West Falkland- Malvinas reach about 850 m in thickness of diamictites and sandstones. The sandstones have been previously described as isolated bodies filling linear channels and small fan-shaped bodies of well-sorted sandstone and minor conglomerate, interpreted as sub-glacial eskers debounding to form small submarine fans. A recent survey of sandstone bodies within diamictite of the Permo-Carboniferous Fitzroy Tillite Formation exposed around Hill Cove, however, suggests a very different interpretation. The sandstone occurs in two forms, as intercalations of cross-bedded sandstone and as tabular, subvertical bodies of massive sandstone, here interpreted, respectively, as coastal, nearshore deposits and clastic dykes. The dykes form an orthogonal network with a main, and more continuous, E-W direction, and a secondary N-S direction. They range from a few centimetres to more than 2 m in thickness, with some dykes exceeding 150 m in length, and thinner dykes wedging upwards. Contacts of the sandstone dykes with diamictite are undulated, probably as the result of compaction. Roughly parallel arrays of coarser grains in the sandstone near the dyke walls are interpreted as flow structures.

When glaciers exert loading upon unconsolidated sediments, dykes may form, but are commonly injected downwards. Flow structures and wedging observed in some of the studied dykes, on the other hand, indicate that unconsolidated sand was forcefully injected upwards, following the hydraulic gradient. Cross-bedded sandstone intercalations as those observed in this study are the most probable source of these intrusions. Liquefaction of the water-saturated sand was probably related to earthquake activity, as the overlying sediments show no evidence of slumping. Dyke intrusion occurred when fluid pressure in the sand exceeded the minimum principal stress, plus the tensile strength of the diamicton.

The orientation of the dykes suggests a regional stress field with E-W maximum and N-S minimum horizontal stress directions, which is also consistent with coeval syn-sedimentary E-W-trending normal faults. If so, this event would have occurred prior to the onset of the tectonic activity in southwest Gondwana.