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Short communication

Haloclasty on the bed of the Lake Gairdner salina, South Australia

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Abstract

Lake Gairdner occupies a blocked valley system within the Gawler Ranges consisting of Mesoproterozoic dacitic rocks physically hard with low porosity and permeability. Haloclasty is developed on the lake and the precipitation of halite causes rock disintegration on the large blocks and boulders that have tumbled from columnar jointed dacite. Some are excessively notched producing mushroom rocks. Occasional wave action during short-lived lake phases carries the detritus away from the sites. The ages of the salina and of the salt crust are not known but are in the order of millennia and centuries rather than millions of years.

Key words: haloclasty, dacite, Gawler Ranges, Lake Gairdner, South Australia.

The effectiveness of haloclasty or salt weathering is clearly demonstrated on the bed of Lake Gairdner, a salina almost 8,900 km^2 in extent occupying a blocked valley system within the Gawler Ranges in the arid interior of South Australia (figure 1). The old valley is overlain by up to a few tens of metres of saline mud that carries a crust of halite commonly about 2 cm thick (e.g. JOHNS, 1968), but occasionally and in places up to 12 cm and with evidence of multiple periods of salt precipitation and intervening periods of sediment deposition (figure 2). The sedimentary cover is thickest over the former valley axis and thins laterally but the salt crust is ubiquitous. After heavy rains the Lake becomes a lake with water several centimetres deep; but it is so shallow that it tends to be heaped by the wind. An extensive but shallow lake at the southern end, for example, can disappear overnight under the influence of a strong southerly, having been pushed to the northern reaches of the lake bed.

Figure 1. Landsat image of Lake Gairdner, South Australia. The latitudinal distance between the NE and SW extremities of the Lake is 120 km. The complex of salinas to the west is Lake Acraman, the last remnants of the scar caused by a meteorite impact some 600 m.y. ago. Note the rhomboidal fracture patterns developed in the Mesoproterozoic silicic volcanics.

Figure 2. Part of salt crust showing three phases of salt precipitation separated by sand depositional events indicative of rain and runoff.

The Gawler Ranges is a massif consisting of ordered rows of bornhardts eroded in various Mesoproterozoic volcanic rocks which crop out in the shoreline of the southern half of the salina and in islands protruding above the salt crust. The dacite that dominates the volcanic sequence is a compact porphyritic rock with laths of feldspar set in a dense fine-grained siliceous matrix. It is physically hard and because of its low porosity and permeability is chemically resistant. So resistant is it that the rounded hills have stood virtually unchanged for 120-130 million years (CAMPBELL and TWIDALE, 1991).

Yet many of the columns of dacite exposed in the shore are undercut where touched by the halite crust (figure 3). Where past heavy rains have caused rivers to flood, rounded cobbles and small boulders have been carried on to the bed of the salina, where they are partly exposed, partly buried in the saline mud and salt crust. The latter causes the sides of these spherical rock masses to be notched (figure 4). Every stage between the narrow platform and the complete elimination of the exposed hemisphere can be seen, with an intact hemisphere remaining embedded in the sediment, with its flat surface standing flush with the halite crust. Clearly the continued precipitation of halite at the surface of the crust causes disintegration. The resultant fragments can be seen incorporated in the adjacent salt crust, or, more rarely, scattered on the surface. Wave action during the occasional and short-lived lake phases carries the detritus away from the sites.

More spectacular results of haloclasty are seen on the large blocks and boulders that have tumbled from columnar jointed dacite exposed in islands in the Lake (figure 5). Some are excessively notched producing mushroom rocks. Perhaps the most dramatic product of such weathering, however, is a flat slab roughly rectangular in plan (some 70 cm x 50 cm) and 1-2 cm thick, standing flush with the salt surface and surmounted by a narrow column, 25 cm high, with concave sides, 6 cm diameter near the base and 14 cm near the rounded crest. This column is all that remains of a once quadrangular block or one possibly hexagonal in cross-section. Assuming a quadrangular or columnar initial shape of the block, at least 75,000 cm^3 (or almost one tenth of a cubic metre) have been eliminated by haloclasty combined with gravity and wave action. The ages of the salina and of the salt crust are not known but are in the order of millennia and centuries rather than millions of years.

Figure 3. Part of the eastern shoreline of Lake Gairdner showing water in the Lake, the salt encrusted shore zone, and undercut dacitic blocks.

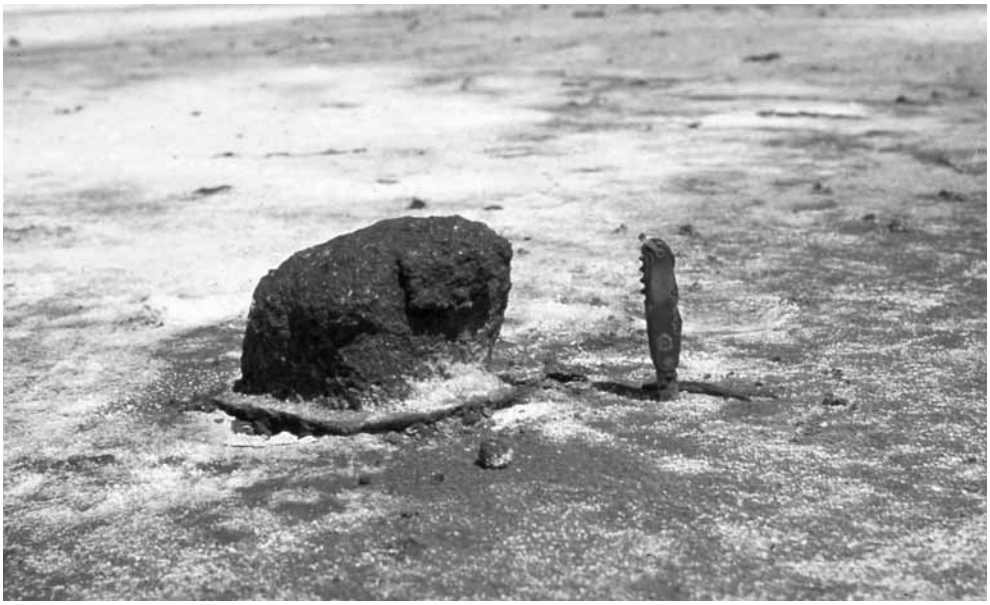

Figure 4. Dacitic cobble with notch and narrow platform caused by salt weathering.

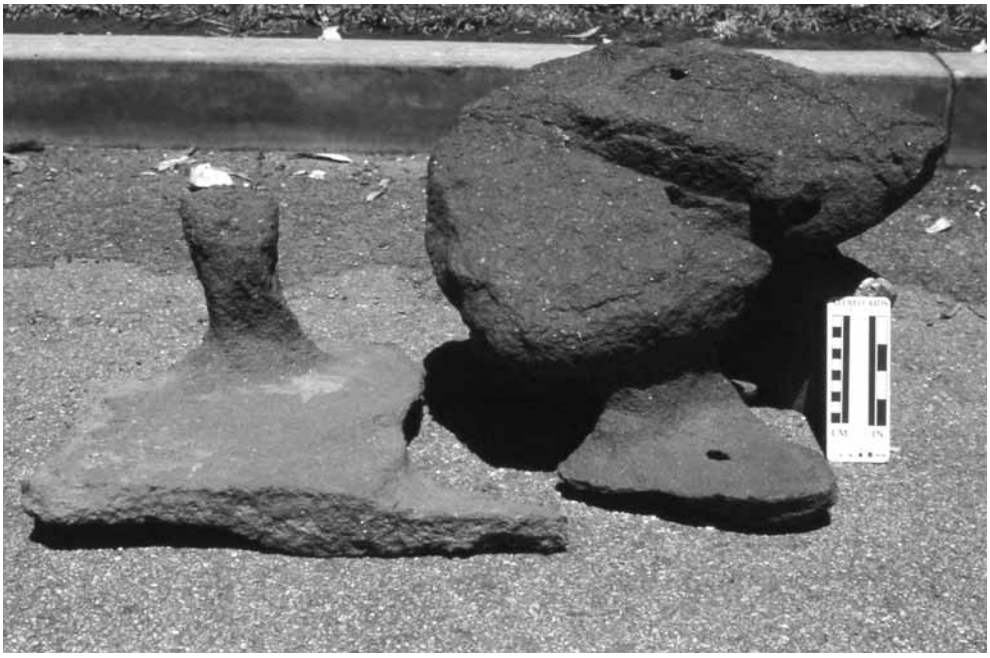

Figure 5. Large blocks affected by salt weathering. On site both stood in the salt crust to a depth of some 2 cm so that the foot of the right hand block was held in the salt crust and the main mass of the boulder stood as a mushroom rock undercut by haloclasty. The platform cut in the left hand block was at the level of the crust, only the prong projecting above the salt surface.

Salt weathering is evidenced on other salinas. For example, undercut blocks comparable to that illustrated in Figure 5 have been observed in gneiss and dolerite on the shore of Lake Greenly, in southern Eyre Peninsula. What makes the Lake Gairdner occurrences notable is that they are shaped in an extremely tough rock.

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