GRAVEL CONES AND DEPRESSIONS: SEDIMENTARY INDICATORS OF INTENSE WINDS

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This note describes groups of unusual gravel cones and depressions forming on an extensive beach which is part of a breached, bay-mouth bar across Holyrood Pond, Avalon Peninsula, southeastern Newfoundland (Fig. 1).

The cones are flat topped with approximately 30° side slopes, up to 0.3 m high, and triangular in profile (Fig. 2). They are graded from pebbles at the base to pea gravel at the apex. The gravel is set in a matrix of sand (Fig. 3). Inverted gravel cones, pebble-lined depressions, also occur but less frequently. The cones and depressions are thought to be generated by intense, short-lived cyclic winds popularly called "wind devils".

The beach upon which the cones occur is subject to steady summer onshore winds from the south-southwest characterized by strong gusts. The nearest station for which wind speed data are available is Argentia airport, 65 kms to the northwest. Average wind speeds during the summer range from 19.3 to 27.2 kms/hr., with gusts reaching 137.6 kms/hr. (Canada Dept. of Transport 1968, for the period 1955-1964). The beach sediments consist of sand and rounded to discoidal-shaped pebbles which are derived from nearby coastal cliffs of till (Eyles and Slatt, In press). Larger pebbles tend to be discoidal and occur as well imbricated pebble pavements behind prominent storm beaches. Smaller pebbles are rounded and lack imbrication. Steady

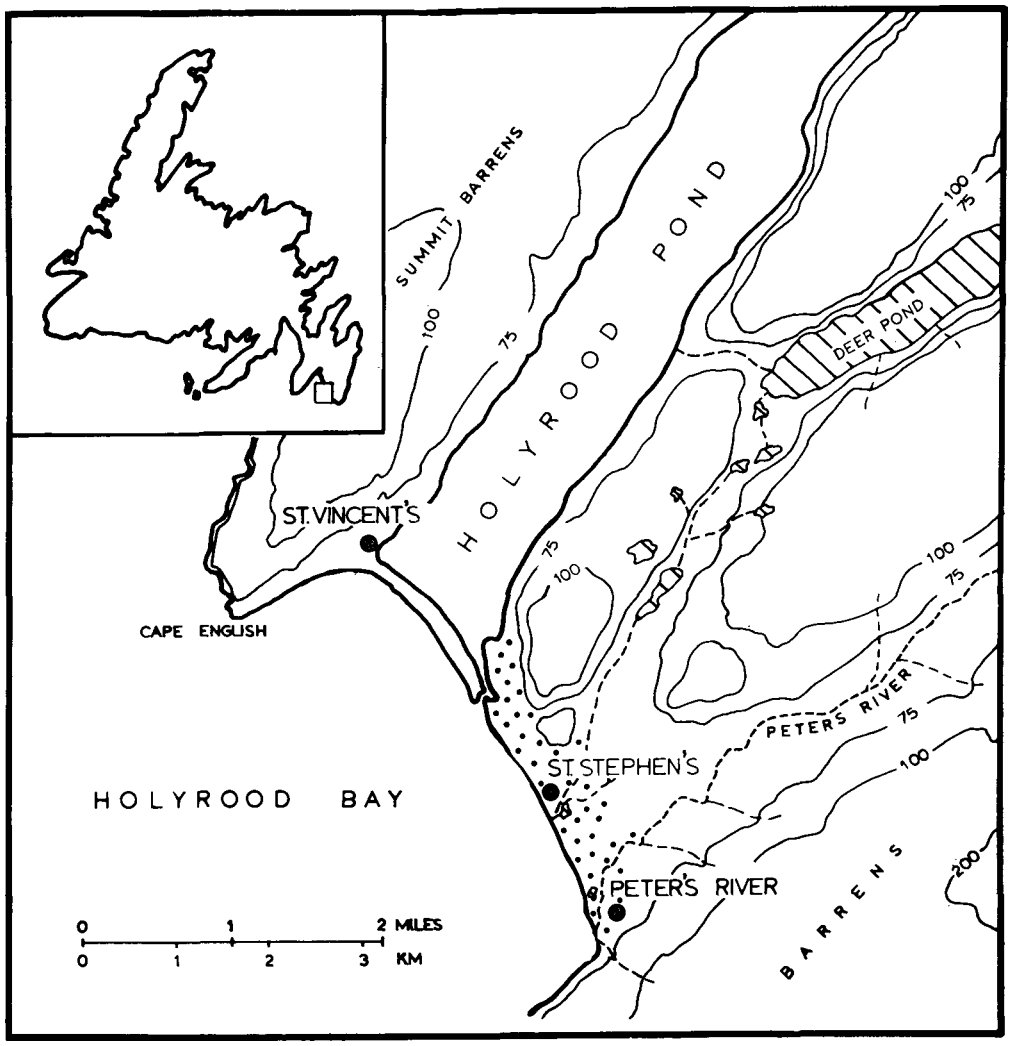

Fig. 1. Location of Holyrood Pond.

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Fig. 2. Newly formed gravel cone. Note key case for scale. In the foreground a gravel cone is being burried by sand.

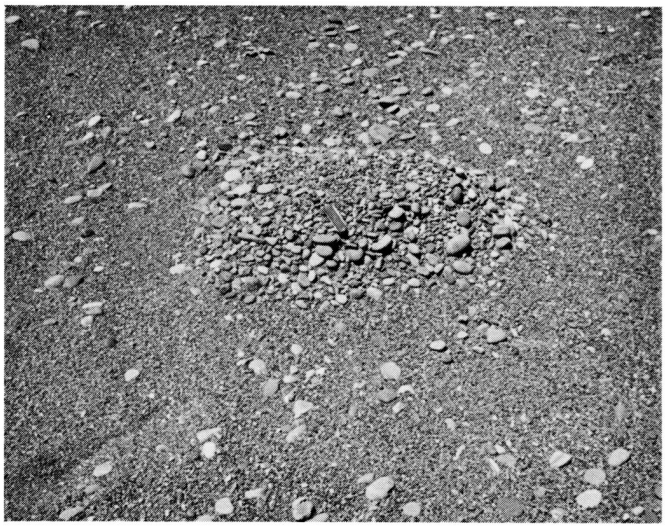

Fig. 3. A mature gravel cone exibiting flat top and graded sides.

Fig. 4. The beach strand. Groups of orientated gravel cones and sand ridges form in response to strong, gusty, unidirectional winds.

winds and an abundant sand supply have resulted in a number of small-scale aeolian forms on the beach surface, as well as various stages of burial of the pebble pavement (Fig. 4).

The cones probably are initially established from random groups of pebbles; local concentrations of pebbles in the beach are uncovered by the removal of the sand matrix. Once established, they will act as loci for the formation of wind devils, and the pebbles become transported in a circular fashion. The gradation in particle size of the cones reflects the wind-velocity gradient within the wind devil. Cone height and width are also controlled by wind velocity since the intensity of flow and the ability to transport pebbles will decrease as the area of the cone is increased. For this reason cones wider than 0.5 m at the base were not found.

Initial depressions on the beach also become the foci of development of wind devils. As sand is removed by wind scour, small-scale pebble lags develop. These depressions appear to be self-maintaining for the same reasons as described above for the cones. The maximum depth and width noted are 15 cm, and the pebbles exhibit imbrication toward the centre. Cones and depressions are seen to be destroyed during periods of heavy rain when pebbles and sand may flow as a slurry.

Importantly, these constructional and destructional features are observed to be buried by sand moving onshore during more normal periods of wind velocity (Fig. 3), and thus may be preserved in the geologic record. Their presence can be used as diagnostic criteria of sedimentary environments over which strong winds and gusts blow. For example, aside from their occurrence on a beach, similar forms have been seen to occur as strong winds blow off modern valley glaciers onto outwash plains (R.M. Slatt pers. comm. 1976). A literature search indicates that such forms have not been previously described.

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