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PERIGLACIAL FEATURES ON JAMES ROSS ISLAND, ANTARCTIC PENINSULA REGION (ABSTRACT)

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In the northeastern part of James Ross Island, which is located in the Weddell Sea, a small ice-free area has developed in the Holocene after retreat of the ice sheet. Under the present severe climatic conditions, periglacial features such as sorted circles, sorted stripes and stone pits actively develop on the ice-free area of the island. Measurements of air and ground temperatures at that site from 1990 to 1991 for a whole year indicate that the mean annual air temperature was $-9.5°C$; freezing and thawing indexes were estimated as 3550°C-days and 186°C-days, respectively. According to HARRIS (Proc. 4th Canadian Permafrost Conf., 1982), these indexes imply that the area is classified as a continuous permafrost zone, and sorted circles are active on the surface of the permafrost. No vegetations cover the ground surface due to summer coldness.

Boulders and gravel are thickly deposited on the gentle slope with an inclination of 4 to 6 degrees. The slope faces the southeast and is on the leeward side relative to the prevailing winter wind. Snow accumulates on the same slope at 20 m higher elevation than the sorted features. Some accumulated snow remains in late summer, and forms perennial snow accumulation. In summer season, meltwater from perennial snow accumulation floods over the gentle slope. But the erosive force is not enough to develop gullies on the slope.

In summer from December until mid-February, the uppermost layer of the active layer is fully saturated by meltwater. The depth of the active layer was estimated as 80 cm or less based on ground temperature records at the depth of 100 cm. Sorted stripes developed on the steeper and upper part of the slop close to the perennial snow accumulation. The sorted stripes are 1.5 m wide and 10 to 15 m long. The borders of the stripes are trimmed by boulders and gravel. The central part of each stripe consists mainly of fine materials; no boulders or gravel were found.

The transition zone of patterns from stripes to sorted circles coincides with the change of slope angle. When the slope changes from 5 or 6 degrees to 4 degrees or less, stripes turn to circles. Sorted circles have a diameter of 1.5 m with nearly round shape. At the end of the slope, circles change to stone pits which are characterized as reversed compositions of materials to circles. Boulders and gravel accumulate in the central part, while the borders of the stone pits consist of fine materials. There are no distinctive differences in the water contents of sediments and active layer depths between sorted circles and stone pits, except for the slope angle. Water ponds are developed in the central parts of stone pits, indicating a surface depressoin in the central part. Freezing and thawing at that location are estimated to occur about 20 times per year. Water saturation in the active layer favors the occurrence

of considerable frost heaving. Generally, active frost heaving tends to occur with fine sediments and sufficient water supply under severe surface coldness. Differential migrations of sediments in active layers occur during freezing and thawing. Boulders and gravel are forced to upheave with fine materials during frost heaving. Only fine materials tend to settle during thawing. Multi-cycles of frost heaving and thaw settling result in the accumulation of boulders and gravel on the surface.

Once boulders and gravel are on the surface, they migrate horizontally from the center to the borders due to the convex form of the sorted circles. These convective movements of materials develop the sorted circles and stone pits. The differences of surface sediments between sorted circles being bordered by gravel and boulders and stone pits bordered by fine materials may be derived from the different direction of convective movements. In case of sorted circles, the convective upward movement occurs at the central part of circles and downward movement sinks into the borders. On the contrary, convective movement of stone pits sinks into the centers and rises at the borders.

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