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Remote mapping of Earth's Earliest Biosphere: Hyperspectral Imagery of the Pilbara Craton and applications for finding niches for life on Mars

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The North Pole Dome (NPD) region in the Pilbara Craton, Western Australia, is a domical structure dominated by greenstone basalts of the early Archaean (3.3-3.5 Ga) Warrawoona Group. The rocks of the Dome are primarily volcanic, with minor volcanoclastic sedimentary successions. These minor volcanoclastic units have been postulated to provide evidence for Earth's earliest biosphere at three different stratigraphic levels (Walter *et al.*, 1980; Groves *et al.*, 1981; Schopf and Packer, 1987). Hydrothermal events have been implicated in mediation of these ecosystems (Van Kranendonk and Pirajno, in press). In order to obtain a regional perspective on hydrothermal activity throughout the NPD, an airborne VNIR hyperspectral survey of the NPD region was undertaken by the Australian Centre for Astrobiology and the CSIRO. Fieldwork to ground truth initial maps was carried out in May-Jun 2003.

An innovative 3D movie of the terrain (DEM) draped by a map of hydrothermal activity has been prepared. Detailed maps of alteration minerals detected during the hyperspectral survey and their spatial relation to known stromatolite and putative microfossil horizons have also been prepared. Regional mineral maps of pyrophyllite, chlorite, sericite, serpentine and other hydrothermal alteration minerals have been developed and new areas of astrobiological interest within the Dome have been uncovered in the process. These include new information about the Strelley Pool Chert, Dresser and Apex Formations. Implications for the Earth's earliest biosphere are presented in graphical form, along with proposed models of hydrothermal activity that could support life on Mars and how such systems might be best detected and interpreted using orbiting hyperspectral remote sensing missions like OMEGA and CRISM.

References

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