PHYSICAL DISPERSION OF RADIOACTIVE WASTES INTO REGOLITH AT THE RADIUM HILL URANIUM MINE SITE, SOUTH AUSTRALIA

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The Radium Hill uranium deposit was mined for radium between 1906 and 1931 and uranium between 1954 and 1961. Rehabilitation was limited to removal of mine facilities, sealing of underground workings and capping of selected waste repositories. Radium Hill has a semi-arid climate and the area is subject to wind and water erosion. In 2002, gamma-ray data, plus tailings, uncrushed and crushed waste rock, stream sediment, soil and vegetation samples were collected to determine the dispersal of mine wastes by wind and water into the local regolith.

The mine and former processing site covers an area of approximately 100 ha. Numerous stable waste dumps of uncrushed rock occur for 800 m along the line of lode. These consist of broken rock material from underground workings and represent the various rock types (feldspar-quartz-biotite gneiss, amphibolite, pegmatite, retrograde rock types, lode material) encountered during mining. Ore grade material (0.1-0.2% U) has significant davidite, high radiation levels (max. 5000 cps; max. 4.2 mSv/hr) and LREE, Nb, Sc, Th, Ti U, V and Y enrichments. Crushed rock material from the mine is found in several dumps in the mine and mill areas, and has been used widely for road and building construction. It is more radioactive than the uncrushed waste rock. Several former mill tailings dams are covered by soil and rock, with the largest containing approximately 0.5 Mt of tailings averaging 200 ppm U. Tailings have elevated radiation levels (1400-5500 cps; max. 3.5 mSv/hr) and prior to covering in the early 1980s, wind deflation and water erosion had caused widespread dispersal into surrounding regolith, with some soils having >90 % of tailings material. Despite partial coverings, mine wastes at the site remain susceptible to water and wind erosion. Regional airborne radiometric data outline the former town and mine sites and roads as pronounced U-Th anomalies.

Capping of tailings storage facilities did not ensure long-term containment of low-level radioactive wastes due to erosion of sides of the impoundments. Continued wind and water erosion of physically unstable waste repositories causes radiochemical and geochemical impacts on local soils and sediments. Additional capping of mine wastes is required in order to minimise impacts on surrounding soils and sediments. However, measured radiation levels are generally below Australian Radiation Protection Standards (20 mSv/year averaged over five consecutive years), except for exposed tailings.

SIR JOHN WAS 'AT HOME' TO VISITING NATURALISTS

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Seven naturalists — Charles Darwin (in Van Diemen's Land, 1836), Dr John Lhotsky (1836-1838), Dumont D'Urville, 1839, 1840), P.E. de Strzelecki (1840-1842), Dr D.J. Hooker and R. M'Cormick with Sir James Ross (1840, 1841), J.B. Jukes (1842) — produced a flood of new information on the geology of V.D.L. All but Darwin had helpful contacts with Sir John Franklin, Governor of Van Diemen's Land, 1837-1843. Previously unrecorded minerals were noted (by Lhotsky), rocks observed and relationships noted (by all the above but particularly by Strzelecki), and fossils collected particularly by Darwin and Strzelecki. Magnetic measurements were made on Mt Wellington by D'Urville, a magnetic observatory set up at Rossbank near Hobart by Ross, and the magnetic variation measured at 24 places on the island by Strzelecki, with anomalies which he atttributed to the natural magnetism in the dolerite. He also made chemical analyses of mineral waters, coals and soils. English palaeontologists noted the similarity of the fossils collected by Darwin and those from rocks of Strzelecki's Second Epoch (now regarded as Permian) to those in the Mountain Limestone (Early Carboniferous) of Britain, of fossils from rocks of the Third Epoch (of P.E. de S., now known to be Triassic) to those in the Coal Measures (Late Carboniferous) of Britain. Leaves (collected by C.D.) and snails (collected by P.E. de S., some possibly from the same locality) were thought to be 'Pleiocene.'

Because of sparsity of outcrops of contacts and lack of skill in interpreting contacts and despite the presence of fossils, little progress was made in establishing stratigraphic and age relationships. Darwin did, however, recognise a volcanic centre, part exposed in shoreline outcrops. Major faults were not recognised, resulting in inability to establish stratigraphic sections. Few minor faults were recognised, exceptions being those associated with the coal on Tasman Peninsula noted by Strzelecki and M'Cormick. In the suburbs of Hobart, Jukes correctly inferred that the greenstone (dolerite) was younger than the Coal Measures but then confused the question of age by inferring that shoreline sections indicated that the greenstone was the older of the two, an error that took more than half a century to correct.

Despite these problems, three of the naturalists produced maps. Lhotsky, in 1837, supported his report on the coal on Tasman Peninsula with a map showing some outcrops and some contacts (as well as a stratigraphic section down a coal shaft), the map and the section being firsts for Van Diemen's Land. The first 'geological' map of Van Diemen's Land by Strzelecki and a section were published in 1845. This was a major achievement, even though the map was largely a rock-type distribution map. It formed the basis of several later maps (Jukes, 1850 and D'Urville, 1854).

The 'Tessellated Pavement' at Eaglehawk Neck is well known for the regularity of the joints. M'Cormick provided the first explanation for it: "The structure ... may probably be due to some re-arrangement of the particles coming under the influence of electro-magnetic forces while passing into a solid state ...". Study of such forces was at the forefront of British science at the time.

The work of the naturalists was published over an extended period. Some of Lhotsky's work on Tasman Peninsula was published locally in 1837. Darwin's work on the geology of the Hobart area first appeared in 1844, followed in 1845 by Strzelecki's publication. Jukes (Palaeozoic formations) and M'Cormick (Geology of Tasmania) published in 1847 and Jukes (1850) included Tasmania and a map thereof in his 'Physical Structure of Australia ...'. Finally, Grange (1854) reported on the geology of Van Diemen's Land, largely after Strzelecki, in the report of the visit by D'Urville in 1839-40.