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# Ubiquitous subaerial weathering at regional and temporal scales during emersion of the Fortescue Late Archean igneous province, Western Australia

Pascal Philippot (1), Yoram Teitler (1,2), and Martine Gerard (3)

(1) Laboratoire de Géobiosphère Actuelle et Primitive, IPGP, France, (2) Laboratoire de Paléomagnétisme, IPGP, France, (3) Institut de Minéralogie et de Physique des Milieux Condensés, France

The 2.77Gy old Mount Roe paleosol at Whim Creek, Fortescue Group, Western Australia, is a reference weathering profile, used for constraining maximum concentrations of atmospheric oxygen and greenhouse gases ($CO_2$, $CH_4$) during the Late Archean (Rye et al., 1995; Sheldon, 2006). Inferences on Early Earth atmospheric composition, however, are based on the interpretation of reconstructed chemical profiles which are not supported by direct mineralogical observations. This in turn resulted in a number of controversies that remain to be solved.

The Whim Creek paleosol is developed at the top of a vesicular, subaerial basaltic flow exposed along two km-scale outcrops located about 5 km away from each other. It mainly consists of fresh footwall basalt progressively grading to a 5 meters thick brecciated chloritic-rich zone showing evidence of corestone weathering, overlain by a 5 to 20 meters thick sericitic-rich zone. Clastic sediments are often inter-bedded between the top sericite zone and the overlying basaltic flow. This is consistent with a significant time gap between deposition of footwall and hanging wall lava flows, a required condition to develop a thick weathering profile.

Similar weathering profiles have been identified both along the same stratigraphic level some 100 km away from the Whim Creek locality (Sherlock River), but also in other formations of the Fortescue Group, such as the 2.74 Gyr Kylena Formation. This indicates that basalt weathering was a long-lasting process that affected large geographical areas. Meter scale blue-greenish titanite-rich bodies preserved as hard cores within sericite zones were discovered both in Whim Creek and Sherlock River outcrops. In addition, remnants of bedded-parallel diaspore/pyrophyllite deposits containing carbonaceous material were found in the Whim Creek sericite zone. Field and petrological investigations indicate that both horizons predate sericitization. Micro-mineralogy analyses are in progress in order to determine whether these horizons contain early weathering-related mineral phases such as greenalite or berthierine (Rye et al., 1995; Sheldon, 2006).

Rye, R., Kuo, P.H., Holland, H.D. (1995). "Atmospheric carbon dioxide concentrations before 2.2 billion years ago." Nature 78: 603-605.

Sheldon, N. (2006). "Precambrian paleosols and atmospheric $CO_2$ levels." Precambrian Research 147: 148-155.