

# Formation of exceptional secondary mineralisation in SW Scotland during the onset of northern hemisphere glaciation revealed by (U+Th)/<sup>21</sup>Ne dating

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The secondary mineralization at Leadhills-Wanlockhead in SW Scotland is a globally-exceptional mineral assemblage that includes over 100 mineral species [1]. It reflects unusual conditions of formation and circumstances of subsequent preservation. The secondary mineral assemblages contain a high-resolution record information on atmospheric and water table conditions. In an effort to develop a genetic model of secondary Pb mineralization we are determining the paragenetic sequence and the fluid compositions and physical conditions of the secondary mineralization. This is hampered by the difficulty in dating secondary assemblage. We have discovered that vanadinite ( $\text{Pb}_4(\text{VO}_4)_3\text{Cl}$ ) contains significant U levels (10-30 ppm) that make it amenable to (U+Th)/He and (U+Th)/Ne dating. The extremely low He concentrations require complete diffusional loss. However, significant concentrations of excess <sup>21</sup>Ne have been measured in all samples. Using the average U content measured in multiple aliquots of vanadinite from the same sample, (U+Th)/Ne ages range from 3 to 5 Ma. This coincides with the onset of northern hemisphere glaciation, and it is tempting to conclude that the environmental conditions necessary to precipitate and preserve such an exceptional secondary mineral assemblage. Ongoing work is aimed at assessing the extent of diffusional loss of <sup>21</sup>Ne from vanadinite, and improving the precision of Ne isotope determinations.

[1] Temple (1956), *Trans. Roy. Soc. Ed.* **63**, 85-115.