

2021 Hutchison Lecture Tour: Dr Vincent van Hinsberg (McGill University)

Deciphering the compositions of fluids in the Earth: Rubies, volcanoes and the origins of life

Earth is the “blue planet,” with more than 70% of its surface covered in water and the equivalent of up to 4 oceans in its interior. This abundance of water has a profound impact on the processes that shape our planet, from ore formation to volcanism and plate tectonics, to the origins and development of life. To understand this impact, it is necessary to know the compositions of these fluids. At present, such information is largely unavailable, because direct samples of fluid are rare, especially for the early Earth and for the deep Earth interior.

In this presentation, I will outline a different approach, in which fluid composition is reconstructed from the geological rock record based on the predictable and characteristic element partitioning between minerals and fluid. Thermodynamics allows us to understand major element mobility, and insights into how elements are built into crystal lattices provides the complementary trace element story.

Unlike fluids, minerals with preserved compositions are readily available in the geological record, and this approach therefore provides a widely applicable tool to reconstruct fluid compositions for the full range of Earth environments and even for its earliest history, and I will illustrate this with examples of my group’s research on ruby formation, volcano monitoring and the development of early life.