Ratios of S-Se-Te in terrestrial mantle rocks: implications for the formation and evolution of the Earth

STEPHAN KÖNIG*[1], AMBRE LUGUET[1], JEAN-PIERRE-LORAND[2] AND D. GRAHAM PEARSON[3]

[1]Universität Bonn, Steinmann Institut für Mineralogie, Germany
stephan.koenig@uni-bonn.de (* presenting author),
[2]Laboratoire de Planétologie et Géodynamique de Nantes, University of Nantes, France
[3]University of Alberta, Department of Earth and Atmospheric Sciences, Edmonton, Canada

Sulphur, Se and Te are chalcophile and highly siderophile elements (HSE) with near-chondritic ratios and absolute abundances in the terrestrial mantle that exceed those predicted by core-mantle differentiation [1]. These "excess" HSE abundances have been attributed to addition of ca. 0.5% of chondrite-like material that hit the Earth shortly after core-mantle differentiation (Late Veneer [2]). Therefore, like other HSE, S, Se and Te are considered potential tracers for the composition of the Late Veneer, provided that their bulk silicate Earth abundances are properly constrained. In contrast to ca. 250 ppm S, Se and Te are ultra-trace elements in the terrestrial mantle. Like all HSE, they are furthermore controlled by base metal sulphides (BMS) and micrometric platinum group minerals (PGMs) [3]. This makes detailed mineralogical and petrological studies of BMS and PGM a pre-requisite to fully understand and accurately interpret the whole-rock S-Se-Te signatures.

Here we demonstrate that the near-chondritic ratios of Se/Te in "fertile" mantle rocks (Se/Te $\approx$ 9) is not a primitive signature of the Earth's mantle, but rather reflects strong enrichment in metasomatic HSE host phases, which erased previous pristine signatures. Consequently, current attempts to identify a potential Late Veneer composition are seriously flawed because, neither refertilisation/metasomatism nor true melt depletion (e.g. harzburgitic residues) have been taken into account to estimate the Primitive Upper Mantle (PUM) composition [4]. Our combined whole rock and in-situ sulphide data indicate a refertilisation trend towards sub-chondritic Se/Te ratios (i.e. Se/Te<2) in mantle-derived rocks. On the other hand, harzburgites that preserve depletion signatures (absence of BMS, low Pd/Ir) show suprachondritic Se/Te ratios (< 40). The metasomatic origin of the S-Se-Te ratios in peridotites that reflect the control of metasomatic BMS and PGMs [5;6], indicate that there is currently no firm evidence for chondritic S–Se–Te signatures in the PUM and that near-chondritic Se/Te ratios in mantle rocks may not readily trace the Late Veneer composition.

[1] Rose-Weston *et al* (2009) *GCA* **73**, 4598-4615 [2] Kimura *et al* (1974) *GCA* **38**, 683-701 [3] Lorand and Alard (2010) **67**, 4137-4151 [4] Wang and Becker (2013) *Nature* **499**, 328–331 [5] König *et al* (2012) *GCA* **86**, 354–366 [6] König *et al* (2014) *EPSL* **385**, 110-121