Hydrogen isotopes in phlogopite indicate crustal fluids in the UG2 layer, Bushveld Complex

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Latypov et al., 2017
The Bushveld Complex: the world’s largest igneous intrusion on Earth

Rustenburg Layered Suite (RSL)
- ultramafic-mafic
- main source for PGE, Cr and V
- crustal contamination (high initial Sr, Nd, Pb, Os)

Veksler et al., JP, 2018

Kruger, 1994
The Upper Group 2 (UG2) chromitite: the world’s largest PGE ore bodies

Water probably play important roles!!! Internal or external?

- locally abundant hydrous minerals, melt inclusions rich in volatile
- addition of H$_2$O to melts causing the melts only saturated in Chr

Oberthür et al., 2016

Ford et al., 1972
Tracing water origins by the hydrogen isotopes in phlogopite

Khuseleka     Nkwe

Khuseleka

Nkwe

Veksler et al., JP, 2018
The phlogopite in the UG2 chromitite

- micro-XRF element maps: 1-3 vol.% phlogopite in the chromitite
- Opx replaced by Phl; Phl coexisting with late magmatic phases
Composition of phlogopite in the UG2 chromitite and adjacent rocks

- relatively constant through the UG2 but within a wide range in the adjacent rocks
- rich in halogens (up to 0.47 wt.% Cl and 0.64 wt.% F)
Hydrogen isotopes in phlogopite indicate crustal fluids in the UG2 layer

- Nkwe chromitite: $-38.2$ to $-25.5\%$
  silicate rocks: $-43.1$ to $-26.1\%$
- Khuseleka chromitite: $-34.6$ to $-31.3\%$
  silicate rocks: $-38.7$ to $-26.1\%$
- Mantle: $-80 \pm 10\%$ (Kyser and O'Neil, 1984)
- Candidates for crustal endmembers in the Transvaal Supergroup (sandstone and shale)
  porewater: $-5 \pm 7\%$ (Clayton et al., 1966)
  dehydration of clay minerals: $-15\%$
  local meteoric water: $-20\%$
- Calculation suggests significant amounts of crustal fluids incorporated in the UG2 magmas