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Whitlockite and (Ba,Ti)-rich mica in Siberian xenoliths indicate 'dry' conditions in parts of terrestrial mantle

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Chemical analyses and Raman micro-spectroscopy have identified whitlockite (water- and halogen-free phosphate) in mantle peridotite xenoliths from southern Siberia. Whitlockite has not previously been reported from terrestrial mantle and igneous rocks, but is the most common phosphate in meteorites and igneous rocks from Mars and the Moon. The presence of whitlockite indicates that portions of the terrestrial upper mantle may be as low in water and halogens as inner parts of the smaller planetary bodies. That inference is further supported by widespread replacement of 'hydrous' minerals (amphibole and phlogopite) in the whitlockite-bearing xenoliths by 'anhydrous' assemblages containing alkali feldspars, Ba-Ti-rich micas and Ti-rich oxides. We infer that those assemblages formed from CO_2- and carbonate-rich fluids, which were either derived from 'dry' mantle domains or formed by liquid immiscibility from alkali-rich silicate melts. The existence of the essentially 'dry' fluids has important chemical, geodynamic and geophysical consequences because water and halogens strongly affect both the conditions of partial melting and the composition of melting products in the mantle.