The composition of serpentinite dehydration fluids in subduction zones: An experimental study

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Subduction of hydrated mantle rocks (serpentinite) contributes to the H_2O and trace element flux through subduction zones. The dehydration reactions responsible for prograde fluid release from serpentinites are now well constrained [1], but we know little about the composition and amount of dissolved matter in these fluids. Using novel experimental techniques, we investigate the phase relations and trace element composition of serpentinite dehydration fluids at high pressure.

Natural antigorite serpentinite (Almirez, Spain) and fractured San Carlos olivine were run together in piston cylinder experiments at P = 3.5-4.0 GPa and T = 750-900 °C. Under all conditions, antigorite breaks down to fluid + garnet + spinifex-textured olivine and orthopyroxene. Chlorite is only present below 800 °C. Exhaustive searching and analysis failed to find evidence of melt in any experiment, indicating that the wet peridotite solidus is above 900 °C at 4.0 GPa.

For the first time, we have trapped and preserved synthetic fluid inclusions in olivine fractures healed at experimental P and T. To our knowledge, these are the highest pressure synthetic fluid inclusions ever produced. Raman spectroscopy and laser ablation ICP-MS analyses reveal that these inclusions consist of H_2O, and are relatively enriched in Sr, Ba, Cs, Pb, Zr, Nb and LREE. Concentrations of B, As and Sb in the inclusions are low, indicating these element may be retained in residual minerals such as olivine or orthopyroxene.

[1] Ulmer & Trommsdorff (1995) *Science* **268,** 858-861.

Chemical characterization of the 5 millenia old leather found in the melting Schnidejoch ice-patch, Swiss Alps

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Optical, chemical and isotopic investigations of the Late Neolithic (2800 BC) leather pants recovered during the summer of 2004 at the 2756 meter-high Schnidejoch ice-patch in the western Swiss Alps [1], were used to get insight into the origin of the leather and ancient tanning procedures. The approach includes, optical and elcectron microscopy, $\delta^{13}C$ and $\delta^{15}N$ of the bulk leather, and molecular and compound specific $\delta^{13}C$ analyses of the organic-solvent extracted lipids. Leather from modern native animals in alpine environment (white-tailed deer, red deer, goat, sheep, chamois, and calf/cow) were analyzed using the same approach in order to test the lipids origin in the ancient lether. Optical and SEM comparisons of Schnidejoch and modern leathers showed that the structure (pattern of collagen fibrils, intra-fibrils lipoidal material) of archaeological leather had survived essentially intact for five millennia.

The $\delta^{13}C$ (–21.2 ± 1.0‰) and $\delta^{15}N$ (2.3 ± 0.9‰) values of Schnidejoch leather are within the range of modern animal tissues ($\delta^{13}C$: –25.4 to –20.3‰; $\delta^{15}N$: 2.5 to 9.9‰) in a preindustrial C_3- environment. The extracted fatty acids include C14:0, C16:0, C17:0, C18:0 and C20:0 (max. at C_{16} and C_{18}), C16:1, C18:1, C18:2, and b-C15:0. All samples show a common pattern of non-saponifiable lipids, based in C_{16} to C_{30} *n*-alkanols, C17 and C26 1,2-alkandiols, some long chain methyl esters and an important group of sterols, mainly, 7α- and 7β-hydroxycholesterol, 5,6-epoxycholesterol and 7-ketocholesterol. The archaeological leather contain also C_{21}-C_{33} *n*-alkanes (max. at C_{31}), C_{14}-C_{24} methyl esters, n-nonacosa-10-ol and very abundant C27, C28 and C_{29} sterols, with cholesterol, cholestanol, β-sitosterol, sitostanol and 7-ketocholesterol as major components.

Most Schnidejoch samples plot within the $\delta^{13}C16:0$ vs. $\delta^{13}C18:0$ and $\delta^{13}C18:1$ vs. $\delta^{13}C18:0$ fields of preindustrial goat leather, indicating that the archaeological leather was produced from goat skin.

[1] Grosjean *et al.* (2007) *J. Quat. Sci.* **22**, 203-207.