Opalescent Glass Bottles from Australian Opal Fields Recent Opal Precipitation?

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On Australian opal fields glass bottles and sherds are found that display opalescence effects on their surfaces after they had been buried in the sediment for some time. The first recorded finding of an opalescent glass sherd dates to 1904. Due to the optical similarity with precious opal it was assumed that the glass surface had been replaced or covered by an opal layer. Possibly the 1904 glass sherd had been part of the sediment for 23 years, since this was the time passed after a gold rush in that same region. Recently found opalescent bottle glass was probably buried in the sediments for several decades, though exact dating is often impossible. In the course of this investigation it became clear that opalescent glass is a general phenomenon in the Australian opal fields. We investigated samples from Andamooka in detail, but found optically very similar bottles and sherds also on other opal fields like White Cliff, Mintabie and Coober Pedy.

According to the locals, old glass bottles only become opalescent when they were buried in the opal level“ where precious opal is found. Thus, we started out our electron microprobe and radiogenic isotope examination of opalescent glass samples with the question if there is a coating on the glass surface and of what matter it would consist.

The foremost result is that there are no opal layers. The color effect results from thin film interference in surface alteration layers of 30 – 80 μm thickness that are characterised by surface-parallel cracks. Within this layer razor-sharp plates with parallel and perfectly even surfaces peel off the glass surface with a thickness down to the sub-micrometer scale. The distances between the parallel plate-to-plate interfaces thus are in the range of the wavelength of visible light.

The chemical process during alteration of the surface layer resembles the process of lateritisation. In the ordinary soda lime glass Na_2O and CaO are reduced from (avarage values) 6 and 9 wt% to 0.5 and 2.5 wt%, respectively. SiO_2 increases from 68 to 80 wt%. Al_2O_3 is strongest enriched and increases from 1.2 to 4.5 wt%. Remarkably the surface layers contain about 1 wt% Cl (0.05 wt% in unaltered glass).

$^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ ratios in bottleglass and the glass surface layers were measured by TIMS and compared to some laterite and clay samples from the opal bearing layer (OL) and the layer (LOL) below that horizon. $^{87}Sr/^{86}Sr$ ratios of the surface layers vary in a narrow range between 0.7096 and 0.7102. The $^{87}Sr/^{86}Sr$ ratio in fresh glass is 0.0006$\pm$0.0001 higher than in the surface layer. Both are nearly identical to laterite in the clay horizons (0.7098 and 0.7103). In contrast OL and LOL reveal $^{87}Sr/^{86}Sr$ ratios between 0.7140 and 0.7207, and 0.7118 – 0.7121 respectively. $^{143}Nd/^{144}Nd$ ratios fall in two distinct groups, namely 0,511558$\pm$52 for the glass samples and 0,512014$\pm$29 for the geological samples. The $^{143}Nd/^{144}Nd$ ratios in the surface layers are 0.000044$\pm$25 higher than in unaltered glass. The isotopic shifts at the glass surface with respect to unaltered glass indicate mixing with a pore water component.

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