The link between biotic and abiotic systems: How and why does gold accumulate in calcrete (caliche)?

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It is well known to mineral explorers that in drier parts of Australia Au accumulates in calcrete (caliche). Calcrete is a Quaternary aeoilan or marine addition to the soil yet it is strongly correlated with Au derived from the weathering of Archean rocks. Why this should be the case is not well understood..

Through a series of recent field observations, laboratory experiments and microanalytical techniques it will be demonstrated that the relationship between gold and calcrete is mediated by both biological and climatic mechanisms. We track the process by which Au becomes adsorbed by plant roots and is translocated to the canopies of large trees. From here the Au is transferred to the soil whereby organic processes involving bacteria, fungi and/or plant roots serve to complex and mobilise Au. Climate affects the uptake of Au in plants and causes it to accumulate in the pedogenic carbonate horizon of soil profiles.

It is important that we elucidate these abiotic-biotic processes if we are to identify the constraints on the Au-calcrete association. Mineral explorers may overlook Au deposits if they fail to understand mechanisms on how soil anomalies form above them.

Geochemical processes during weathering of natural volcanic glasses: comparison with experimental alteration

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The objective of this research, currently in progress, is to study the weathering processes of glassy silicate materials, in order to understand the geochemical processes involved and the variation of mineral phases as a result of alteration.

The use of samples of natural glass of volcanic origin has allowed to obtain some powder or sections of fresh silicate glass that have been subjected to artificial alteration in the laboratory, in order to model the geochemical processes that have occurred.

Moreover, the study of naturally altered samples has allowed to observe the effects of weathering after a period of time corresponding to the age of the sample. Three samples were collected in the eastern Sicily, Italy. They include the rhyolitic obsidian of historical age coming from the island of Lipari (Aeolian Islands) in the southern Tyrrhenian Sea, connected to a complex subduction-related magmatism. The second one is a glassy salband from a basaltic dike outcropping in the western wall of the Valle del Bove (Etna), having an estimated age between 15 and 60 thousand years. The third sample is a glassy crust of tholeiitic pillow lavas from submarine eruptions of the upper Pliocene in shallow water environment in the northwestern Iblean Mountains.

The characterization of the samples was obtained by Raman spectroscopy, which showed the effects of the devitrification and the presence of some secondary minerals such as phillipsite and offretite, two varieties of zeolite found in the cavities of oldest basalts.

Samples have been altered from 1 to 100 days of experiment. Alteration experiments were conducted in pure water at 90°C; solid modifications were observed by SEM. The analysis showed the formation of an amorphous material surface characterized by a slight decrease in the content of silica, alkali and calcium, and by a marked increase in titanium (up to 3.17%) and iron (up to 16.21 %) contents.

All these results allow to test the geochemical modeling in the long term. Further analysis will be needed to reach a full understanding of the weathering of glassy materials, in order to prevent the environmental pollution caused by the alteration of vitrified metallurgical or radioactive waste.

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