



Minerals and trace elements in silcretes of the Sado basin (Alentejo, southern Portugal) and implications for silcrete formation

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Soils in the eastern part of the Sado basin (southern Portugal) are often characterized by massive cementations caused by silica. The thickness and massive character of these silcretes led to the hypothesis that accumulation of silica took place not only vertically within a soil profile, but also by enrichment through lateral water and element flow into the Sado basin. The aims of the study reported here were: 1) to characterize the cementing agent with regard to its mineralogy; 2) to test the hypothesis that silification was enhanced through lateral silica transport from the adjacent Alto Alentejo into the Sado basin.

Aim 1) was achieved by scratching silica coatings from ped surfaces of the silicified soil horizons and cleaning them manually in the lab under a binocular microscope. After careful smashing with a mortar, density separation by sodium polytungstate solution was applied to remove any remaining mineral grains from the silica samples. The cleaned silica samples were then subjected to XRD and SEM in combination with EDS.

Aim 2) was attained by using trace element contents of predominant rock types of the Alto Alentejo and of the silcretes in the Sado basin for identifying lateral pathways of water and silica in the landscape. Ten rock samples from the assumed source area of silica were combusted by fusion melt, and their contents of Ba, Co, Cs, Nb, Pb, Rb, Sr, Y and Zr were analyzed by ICP-MS. The same elements were analyzed in NaOH extracts of the cemented soil horizons in the Sado basin.

The X-ray diagrams of the silica coatings show the expected broad hump of amorphous silica. In addition, quartz, kaolinite, and surprisingly high amounts of halloysite are identified, the latter reflecting conditions of intensive weathering and pedogenesis during the formation of the silica coatings. This intensive soil formation and hence silification most likely took place during Pliocene. Greater age is impossible, because the silification took place in Pliocene sediments; later, on the other hand, the climate became cooler, hence intensity of pedogenesis should have decreased. It is assumed that halloysite was preserved over such long period of time, because it was occluded in the silica mass. The micromorphology of the coatings under the SEM includes laminar coverings, banded and alveolar structures. EDS analysis shows that the coatings consist mainly of silicon; in addition they contain aluminum and some also have minor amounts of iron.

Trace element contents of the rock samples and silcretes enabled tracing lateral silica flows from the Alto Alentejo into the Sado basin. Some rock samples and silcretes contained considerable amounts of Barium. Even barite crystals were observed in the silica coatings under the SEM.

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