

Characterization of the eolian dust sources by ESR of impurity centers in quartz

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The change of atmospheric circulation system in the past is an important issue for studies of paleoclimate. Eolian dust, fine particle suspended in air and brought by wind, is a key to know the wind direction and the strength in the past. It was found that its origin is different between in the last glacial maximum and in Holocene by measuring the number of oxygen vacancies, indicated by the intensity of the E_1' center, in quartz in loess. Later, the crystallinity index was found to be another proxy for such studies. In the present study, we examined if the impurity centers, detected by ESR (electron spin resonance), are useful proxies as well. The impurity centers could indicate the concentrations of the impurities in the matrix. As the impurity centers are unstable on heating, their natural intensities would be dependent on surrounding radioactivity and temperature. We irradiated gamma rays, after heating the sample to eliminate the natural signal. Formation efficiency and saturation value by the irradiation were examined.

Fine grain fractions were taken at Chinese desert. They were treated with acetic acid of 20% 50ml for 8 hours. Sodium citrate ($\text{Na}_3\text{C}_6\text{H}_5\text{O}_7$) 40ml of 0.3 mol/l and NaHCO_3 5ml of 1 mol/l and a mixture of hydro-sulfide sodium ($\text{Na}_2\text{S}_2\text{O}_4$) 3mg were added and heated at 80 degrees C for 8 hours. Subsequently, the samples were treated with hydrogen peroxide solution (H_2O_2) of 20% and heated at 60 degrees C for 8 hours. Then, they were soaked in hexafluorosilicic acid for one week. The fine size fraction less than 16 micrometers were extracted. we heated at 300 degrees C for 4 hours. Four different gamma ray doses were given irradiation between 0 - 2200Gy to the samples. The samples for the oxygen vacancies measurement was not heated before irradiation to 1000Gy. The Al center and the Ti center were observed by ESR measurement at low temperature (81K). The Ge center and the E_1' center were measured at room temperature. No Ti and Ge centers were observed in these samples, indicating that these can be proxies which indicate Japanese origin. The saturation level of the Al center intensity was found to be a proxy possibly useful to characterize Chinese deserts as well as oxygen vacancies.