Application of γenergy spectrum in the study of paleoenvironment

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Low-background and multi-channel γenergy spectrometer is used to measure a typical Xigeda group (lacustrine sediment formed between the late Tertiary Period and the early Quarternary Period) profile in Panzhihua, China. By employing this method, the changing rules of URa, Th and K are analyzed, the result of which, together with the geologic featureas and the features of the sediments on the profile, reveals the characteristics and the changing rules of the paleoenvironment.

The results show that the data got by the γspectrum have obvious rules and the contents of the radioactive nuclides drop gradually from the old Xigeda group layer to the new. According to the radioactive characteristics, the profile, which is 31.5m thick, can be divided into 6 cycles and 22 layers. For each cycle, the contents of the radioactive nuclides first rise and then drop. The bottom of the profile is mainly composed of thin, blue-grey mudstones, while the top of it is mainly composed of thick, sallow or light grey-purple siltstones. By comaparing theγspectrum results and the geologic features, it is found that they are similar and can confirm each other. The paleoenvironment reflected by them also have similar and regular changes, with the bottom being oxygen-free environment (blue-grey mudstones of thin granule) and the top being oxydizing environment (grey-yellow siltstone of thick granule). This shows that, in the oxygen-free environment, the rainfall was enough, the lake was deep and the climate was humid; whereas in the oxydizing environment, the rainfall reduced, the lake was shalow and the climate was rather dry. Meanwhile, similar environmental changing rules also occur in each cycle, that is, from the bottom to the top in each one, the environment changes from humidity, to semi-humidity, then to semi-drought, and then to drought. All these illustrate that γenergy spectrum is an effective method for the study of paleoenvironment.

Water speciation in hydrous (alumino)silicate melts/glasses and quasi-chemical modeling

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The dissolution mechanism of water in (alumino)silicate melts/glasses has long been controversial. Recently, we have made much progress through the application of advanced solid-state NMR techniques to hydrous glasses of a range of compositions, including depolymerized Al-free silicate (e.g. $CaO-MgO-SiO_2$)[1-2, 7], (nominally) fully polymerized aluminosilicate (e.g. $SiO_2-NaAlO_4$ join)[3-4] and partially depolymerized aluminosilicate ($CaMgSiO_6-CaAl_2Si_2O_8$ join)[5-6]. Here we review some of the results.

Combined quantitative ^{1}H MAS NMR and selective double-resonance ^{29}Si-^{1}H and ^{27}Al-^{1}H NMR studies have unambiguously revealed the presence of several different types of hydroxyl (OH) species, including SiOH, AlOH and free OH ((Ca, Mg)OH), in addition to molecular H_2O [1-7]. The distribution of water speciation as a function of composition can be described in terms of a quasi-chemical model by a set of homogeneous reactions that relate the anhydrous and hydrous oxygen species [4, 7]:

Polymerized aluminosilicate [4]:	Al-free silicate [7]:
SiOSi + AlOAl = 2SiOAl	SiOSi + MOM = 2SiOM
SiOSi + H2O = 2SiOH	SiOSi + H2O = 2SiOH
SiOAl + H2O = SiOH + AlOH	SiOM + H2O = SiOH + MOH
AlOAl + H2O = 2AlOH	MOM + H2O = 2MOH

The obtained equilibrium constants near the glass transition temperatures suggest that the relative abundances of different OH species are largely governed by the relative stabilities of the anhydrous oxygen species. This represents the first step toward quantitative modeling of the thermodynamic and physical properties of silicate melts.

[1] Xue, X. & Kanzaki, M. (2004) *Geochim. Cosmochim. Acta* **68**, 5027–5057. [2] Xue, X. (2009) *Am. Mineral.* **94**, 395–398. [3] Xue, X. & Kanzaki, M. (2006) *Am. Mineral.* **91**, 1922–1926. [4] Malfait & Xue, X. (2010) *Geochim. Cosmochim. Acta* **74**, 719–737. [5] Xue, X. & Kanzaki, M. (2007) *Solid State Nucl. Magn. Reson.* **31**, 10–27. [6] Xue, X. & Kanzaki, M. (2008) *Geochim. Cosmochim. Acta* **72**, 2331–2348. [7] Xue, X. & Kanzaki, M. (2009) *J. Am. Ceram. Soc.* **92**, 2803–2830.