Characterization of CL halo in feldspar minerals

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Feldspar occasionally has a visible radiation damage halo surrounding radionuclide-bearing minerals within it. Until now the formation of such halo has not been investigated in detail. In this study, cathodoluminescence (CL) of He+ ion implanted feldspar minerals have been measured to characterize the halo for geodosimetry and geochronology.

Single crystals of sanidine ($Or_{90}Ab_{10}$) and albite ($Ab_{99}Or_1$) were selected for CL and Raman measurements. He^+ ion implantation in the sample was performed on a 3M-tandem ion accelerator at 4 MeV corresponding to the energy of alpha-particles from disintegration of ^{238}U. A CL scanning microscopy (SEM-CL), SEM (JEOL: JSM-5410) combined with a grating monochromator (OXFORD: Mono CL2), was used to measure CL spectra ranging from 300 to 800 nm at 15 kV acceleration voltage and a beam current of 1.0 nA.

CL images of sanidine and albite exhibit CL halo in the surface of He^+ ion implanted samples. Approximately 15 micro meter width of CL halo might be consistent with theoretical range of alpha-particles from disintegration of ^{238}U in these feldspar. CL intensity of sanidine gradually decreases from the implantation surface to the inside up to approximately 15 micron meters, over which it jumps up to bulk emission level of non-implanted area. CL line analysis in the section of halo area and Raman spectroscopy reveal that He^+ implantation causes structural destruction, especially breakage of framework configuration, suggesting reduction of emission centers such as Al-O^--Al defect in halo. On the other hand, albite shows the increase of CL intensity exponentially from the surface to the inside, with its maximum at approximately 15 micron meters from the surface. This CL emission from the halo might be assigned to radiation induced luminescence centers formed by He^+ ion implantation.

C isotopes and multi-elements distribution within individual Proteozoic microfossils

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Early evolution of life during Precambrian time is characterized metabolic development in micro-organisms (e.g. Schopf [1]). Though many of modern micro-organisms share similar cell morphology (e.g. spheroidal, filamentous) they are highly diverse physiologically. Thus, it is inadequate to decipher the physiology of fossil micro-organisms based only on morphology. Carbon isotopes and elemental compositions of individual microfossils have potential to preserve the physiological information such as carbon fixation pathway and substrate [1-3]. We here analyzed carbon isotopes and elemental compositions of individual microfossils from Proteozoic stromatolite, using by NanoSIMS. Using primary Cs^+ ion beam, carbon isotopes were measured at 1.5 μm spatial resolution, while intracellular distribution of multi elements (H, C, N, P, S) were analyzed at 100 nm spatial resolution. Carbon isotopes and elemental compositions are characteristic to fossil cell morphology (filamentous and radial shape). However, within the microfossils with similar morphology, significant variations in carbon isotopes (20‰) and elemental compositions are also observed. Based on the carbon isotopes and elemental compositions as well as information on morphology and petrography, we will discuss the physiology of those microfossils.

[1] Schopf (1994) in Bengtson (ed.) *Early Life on Earth*, Columbia Univ. Press, pp.193-206. [2] House *et al.* (2000) *Geology* **28**, 707-713. [3] Ueno *et al.* (2001) *Inter. Geol. Rev.* **43**, 196-212. [4] Oehler *et al.* (2006) *Astrobiology* **6**, 838-850.