Quantifying trace element distributions in agate banding by LA-ICP-MS

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Samples

Agates are banded forms of microcrystalline chalcedony often forming spectacular, colorful geodes or veins. Two analyzed agates are characterized by the rhythmic banding of redish and bluish layers, respectively, ranging in width about 50 mm. Boundaries between each layer are well distinguished by the slight contrasting in color. The color of agates can vary with the species and concentration of trace elements. Agates thus can provide direct visual evidence for correlations in concentrations among trace elements and between trace element concentrations and color contrasts.

Analytical methods

X-ray mapping was carried out using a Shimadzu EPMA 1600. Subsequent quantitative mapping was performed using a NewWave 213 nm Nd:YAG laser ablation system attached to a Thermo X2 quadrupole ICP-MS, with instrument settings at 11 J/cm^2 for energy density, 10 Hz repetition rate, 55 μm beam size, 60 μm spacing between adjacent line scans, and 10 μm/s scan speed. The oxidation rate was controlled below 1%. NIST612 glass was used as the external standard, and ^{29}Si as the internal standard, assuming stoichiometric quartz. Data reduction was carried out using Iolite software.

Results

Among 9 trace elements including Al, Ca, Co, Fe, Ti, Cr, Mn, Cu and Ni. Al and Fe are the most abundant, up to ~5000 ppm in red agate and up to ~500 ppm in blue agate, whereas concentrations of other elements are less than 400 ppm. All the quantitative elemental maps except Cr and Ni show that trace elements are concentrated in the boundaries between each layer. Quantitative Al and Fe maps show a harmonious behaviour of Al and Fe in red agate, but an antithetic relationship in blue agate. The Al and Fe distribution patterns in red agate are reproduced in the Al Kα and Fe Kα X-ray maps, but not clear in blue agate. All the above results suggest that quantitative elemental maps using LA-ICP-MS are previleged to visualize trace elements distributions.

Pb and stable Pb isotopes in sediments of the eastern coast of the Yellow Sea

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In order to investigate the distribution and sources of Pb in coastal sediments in the Yellow Sea, 88 surface sediments were collected and analysed for Pb concentration (1M HCl leached and residual fractions) and stable Pb isotopes (^{207}Pb/^{206}Pb, ^{208}Pb/^{206}Pb) using MC-ICP-MS.

Leached Pb concentration varied in the range of 3.8-28.8mg/kg (mean 11.3mg/kg) and showed the highest concentration in the fine-grained sediments and seemed to be associated with Fe oxide/hydroxide. Pb concentration in the residual fraction showed 2.6-18.1mg/kg (mean 11.1mg/kg) range and higher concentration in coarse-grained sediments, which indicated that high Pb were resulted from K-feldspar abundant in sand, which were consistent with the previous study[1].

^{207}Pb/^{206}Pb and ^{208}Pb/^{206}Pb varied in the range of 0.844-0.851 and 2.102-2.118, respectively. Pb isotope ratios decreased from the northern part toward the southern part. Based on the ratio-ratio plots and ratio- the inverse of Pb concentration plots, the spatial distribution of isotopes were resposible for the mixing between materials borne from Korean rivers (the Han and Geum)[2] in the northern part, and the mixing between the Geum River borne sediments and offshore sediments [2]in the southern part.

[1] Kim *et al* , (2001) JKSO, **35**, 179-191 [2] Choi *et al* , (2007) Mar. Chem. **107**, 255-274

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