Combined microspectroscopic characterization of a red-colored granite rock sample

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Tenzan granite, Saga, Japan, has reddish color portions spreading from a grey prehnite vein over about 10 mm. However, origins of red coloration remain unclear. Combined microspectroscopic mapping have been conducted on a Tenzan granite sample by using an original visible/fluorescence/Raman microspectrometer together with a low vacuum scanning electron microscopy–energy dispersive spectrometry (SEM-EDS) without coating.

Visible darkfield reflectance spectra were converted to L*a*b* color values and Kubelka–Munk (KM) spectra. Large a* value (red) positions correspond to large band areas at 500–560 nm, possibly due to hematite-like iron oxide, while large b* value (yellow) positions to large band areas at 450–500 nm, due to epidote-like mineral. SEM-EDS analyses indicated that the reddish parts are Na and K-feldspars with low Fe contents (<0.5wt%). Raman microspectroscopy could not detect hematite-like minerals. Since some hematite-like minerals were identified by electron diffraction patterns under transmission electron microscope, they are considered to be submicron microcrystals disseminated in feldspar matrices.

The KM spectra for prehnite-like minerals show a weak broad band around 430 nm due possibly to a ligand field band of Fe^{3+} without clear Fe^{2+}–Fe^{3+} inter-valence charge transfer (IVCT) bands around 720nm. Therefore, Fe in prehnite is not considered to be present as hematite-like iron oxide, but can be mainly present as Fe^{3+} replacing Al^{3+} in the crystal structure.
Since determination of physicochemical states of Fe such as valence and coordination states (Fe^{2+} or Fe^{3+}, oxide or in crystal lattice, etc.) and their distributions are extremely difficult, especially in complex colored rocks, the present combined microspectroscopic methods are useful for their nondestructive characterization.

Keywords: red granite, hematite, visible microspectroscopy, color values, band area map, SEM-EDS

