Supplementary material

Title: First application of photon-counting computed tomography using scintillator-based photon counter to rock samples: Preliminary results and prospects

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Petrography of a carbonate vein in orthoquartzite from the Tetori Formation

Studied sample of quartzite in sandstone boulder of the Tetori Formation was collected by TM from the Tedori River in Ishikawa Prefecture, Japan (latitude 36.44N. longitude 136.63E). Carbonate vein in orthoquartzite (and sandstone) is composed mainly of carbonate and quartz (Qz) with trace amounts of pyrite (Py) (Figures A1 and A2). Carbonate minerals are mostly Fe-rich dolomite (13-15 wt.% FeO), with a few FeO-poor dolomites (4.5 wt.%) observed (Table A1).
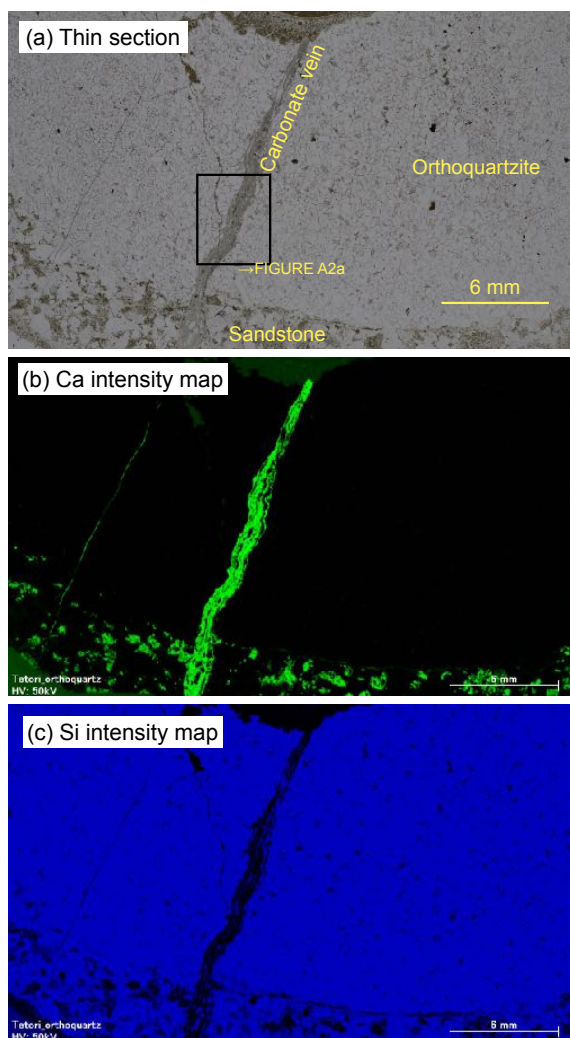

FIGURE A1. (a) Thin section image of carbonate vein in orthoquartzite and sandstone from the Tetori Formation. X-ray intensity maps of Ca (b: green) and Si (c: blue). X-ray intensity maps were obtained with micro X-ray Fluorescence (XRF, M4 TORNADO Plus, Bruker, USA) at Akita University. The

Rh X-ray tube voltage and current were 50 kV and 600 µA. Scanned areas were acquired with 4 ms for each 20 µm step.
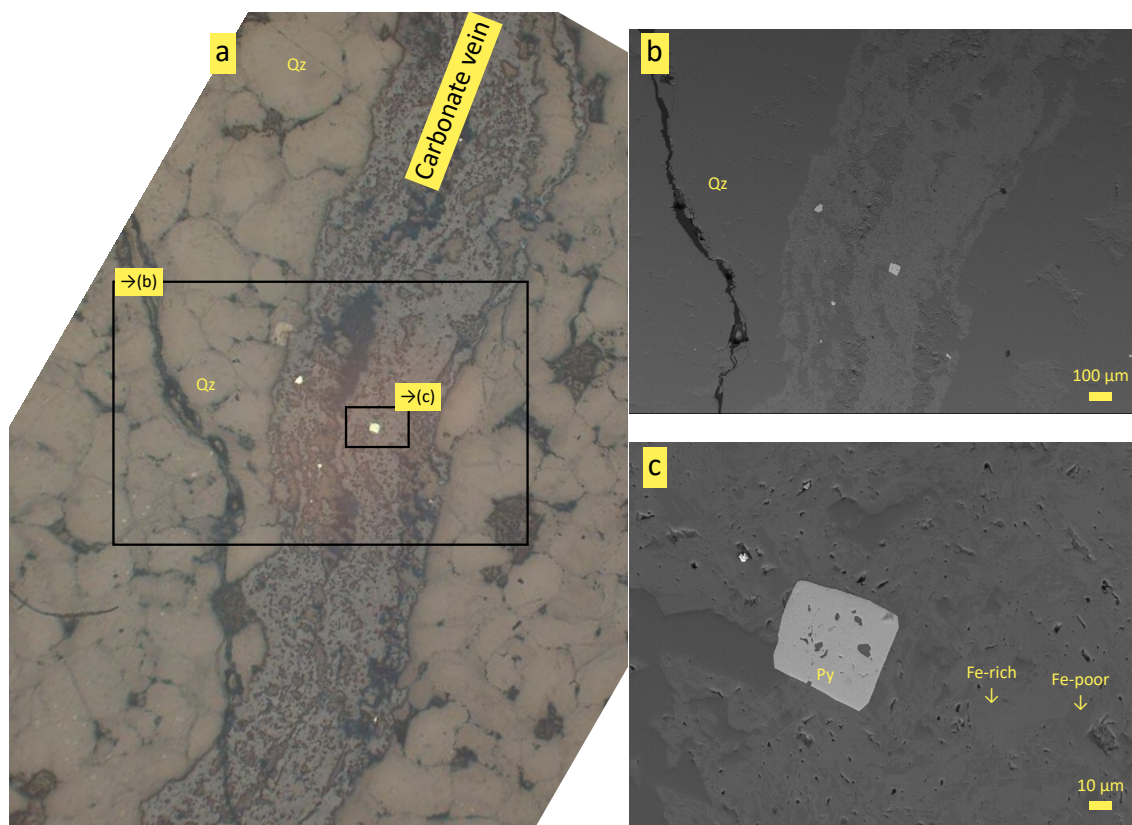

FIGURE A2. Photomicrograph and FE-SEM images of carbonate vein in orthoquartzite from the Tetori formation. (a) Reflected light image. (b) and (c) Back-scattered electron images of a part of (a). Qz = quartz, Py = pyrite, Fe-rich = Fe-rich carbonate and Fe-poor = Fe-poor carbonate.

Carbonate composition in carbonate vein in orthoquartzite from the Tetori Formation

Analytical Method

Carbonate minerals were analyzed by a field emission-scanning electron microscope (FE-SEM: JEOL JSM-7100) equipped with energy dispersive X-ray spectrometry (EDS: INCA Energy System, OXFORD) at Kanazawa University. To reduce damage caused by electric current irradiation, a 10,000 times magnification scan mode was used for both standard and analyzed samples. The SiO_2, TiO_2, Al_2O_3, Cr_2O_3, FeO, MnO, MgO, CaO, Na_2O, K_2O, P_2O_5, and NiO contents of each analyzed spot were checked to determine whether other phases were contaminated with the analyzed spot. The standard materials used in the analysis were both natural and synthetic: quartz for Si; K, Ti and P for $KTiPO_4$; Al for Al_2O_3; Cr for Cr_2O_3; Fe for hematite;

Ca for wollastonite; Na for jadeite; and Ni for NiO. The detection limit for each element is calculated from the standard deviation value of the background counts of multiple standards that do not contain the target element and the net counts of the standard for the target element. Typical detection limits are 0.15 wt. % for Al_2O_3, MgO, Na_2O, K_2O, 0.2 wt. % for CaO and P_2O_5, and 0.3 wt. % for TiO_2, Cr_2O_3, FeO and MnO, and 0.4 wt. % for NiO. In-house prepared minerals, such as olivine, clinopyroxene, spinel and potassium feldspar are also analyzed to confirm analytical precision and accuracy. The precision of the analysis is evaluated by one relative standard deviation (RSD) for the analysis results in 9-10 analyses. The RSD for all analytical conditions was less than 2 % for elements with concentration greater than 10 wt. % and less than 5 % for elements with concentration of 2-10 wt. %. Average values measured by SEM-EDS agreed within 5 % for elements with concentration of > 2 wt. % with recommended values of in-house minerals. Typical carbonate composition is shown in TABLE A1.

TABLE A1 Representative carbonate composition (wt. %)

	Spot #	FeO*	MnO	MgO	CaO
Fe-rich	OQ-1-1	13.8	0.6	11.6	28.3
	OQ-1-4	13.0	0.5	11.5	28.3
	OQ-1-5	12.8	0.7	12.1	28.1
	OQ-4-1	13.1	0.5	11.7	27.6
	OQ-6-1	13.4	0.6	11.3	28.3
	OQ-15-1	13.6	0.7	10.8	27.7
	OQ-15-2	14.8	0.7	9.0	28.5
Fe-poor	OQ-6-2	4.6	BDL	15.9	30.9
	OQ-15-4	4.5	BDL	15.5	29.5

Spot # = analytical point number, FeO* = All Fe is treated as Fe^{2+}, BDL = below detection limit of analysis.