

Zircon behavior in the upper amphibolite facies polymetamorphic terrane, Ryoke belt, Japan

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In the Ryoke metamorphic belt at the Aoyama area, SW Japan, pelitic schists and migmatites are widely outcropped, and the *P-T* condition of the regional metamorphism by which they were formed is estimated to be 3.0–4.0kbar, 615–670°C for the Sil-Kfs zone at the north, and 4.5–6.0kbar, 650–800°C for the Grt-Crd zone at the south [1]. The U-Th-Pb dating of the monazite in migmatites yielded 96.5±1.9Ma mainly preserved in the monazite core, and domains and rims of 83.5±2.4Ma. Although the contact metamorphism by the Ao granite at the south (79.8±3.9Ma) was not detected from the major metamorphic minerals, the coincidence of the age suggests that the Younger Ryoke granite including the Ao granite caused the contact metamorphism to the regional metamorphic rocks [2].

In the Grt-Crd zone where metamorphic temperature increases toward the south, zircon grains larger than 20 µm in diameter were abundant in the north than in the south. The comparison between the modal amount of zircon larger than 20µm and the whole-rock Zr concentration suggests that most of the whole-rock Zr was resided in zircon larger than 20µm in the north, whereas zircon larger than 20µm can account for only 20-30% of the whole-rock Zr in the south. The U-Pb dating of zircon by LA-ICPMS showed that most of the zircon larger than 20µm from the northernmost part of the Grt-Crd zone are detrital in origin. On the other hand, in the pelitic migmatite from the area where metamorphic temperature of 720 °C is estimated, several grains of ~100Ma zircon larger than 20µm were found.

These observations suggest that upper amphibolite grade metamorphism that potentially lasted about 5Ma [3] is not sufficient enough to (re)crystallize new zircon larger than 20µm, although monazite is almost completely rejuvenated. It is necessary to date tiny-grained zircon less than 20µm, or instead, use monazite in order to date upper amphibolite facies metamorphism.

[1] Kawakami (2001) *JMG* **19**, 61–75. [2] Kawakami & Suzuki (2011) *JpGU meeting abst.* SCG008-01. [3] Suzuki *et al.* (1994) *EPSL* **128**, 391–405.

Increased stable carbon isotopic ratios of oxalic, malonic, and glyoxylic acids in the Arctic aerosols during polar sunrise and after

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Low molecular weight dicarboxylic acids such as oxalic acid (C₂) are present abundantly in aerosols. Because they are water-soluble, dicarboxylic acids can enhance the hygroscopic properties of atmospheric particles. During the polar sunrise season at Alert, Canadian Arctic, we observed photochemical production and loss of small diacids [1]. Although C₂ is the dominant diacid species in winter to spring, it was replaced by succinic acid after polar sunrise in May. Oxalic acid was preferentially decomposed when a solar radiation was intensified and the atmospheric transport from mid latitudes was ended in May. In this study, we applied compound-specific isotope analysis for diacids and related compounds isolated from the Arctic aerosols collected from late winter to early summer including dark winter and polar sunrise seasons.

Stable carbon isotopic ratios (δ¹³C) of small dicarboxylic acids and ketoacids were measured in the Arctic aerosols after derivatization to butyl esters and/or dibutoxy acetals using a capillary gas chromatography combined to on-line combustion/isotope ratio mass spectrometer [2]. We found that δ¹³C of C₂ increased from -23‰ in early March (before polar sunrise) to -5‰ in May (after polar sunrise). Malonic acid (C₃) also showed an increase of δ¹³C from late February (-25‰) to early May (-17‰). Glyoxylic acid (HOC-COOH), a precursor of C₂, showed similar increase from -18‰ in late February to -10‰ in May. Glyoxal (HOC-CHO), another precursor of C₂, showed very high isotopic ratios up to +15‰. In contrast, isotopic composition of succinic acid (-32‰ to -24‰) did not show a systematic trend. An increase in δ¹³C values is probably associated with photochemical ageing of aerosols. It is likely that ¹²C-¹²C bonds of oxalic and other species decompose preferentially over ¹²C-¹³C bonds during photochemical ageing. Isotopic fractionation of C₂ and its precursors may also be likely during the gas/particle partitioning. Here, we propose that δ¹³C of oxalic acid can be used as a photochemical tracer for the ageing of organic aerosols.

[1] Kawamura *et al.* (2010) *J. Geophys. Res.* **115**, D21306, doi, 10.1029/2010JD014299. [2] Kawamura & Watanabe (2004) *Anal. Chem.* **76**, 5762–5768.