Carbon and oxygen isotopes and ^{14}C age of travertine and spring water in NW Iran

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Travertine is calcium carbonate precipitated from spring water, groundwater and so on and is widely distributed in northwest Iran. It is one of suitable samples which can reconstruct paleoenvironment on land with a high resolution because of its high deposition rate (1 –20 mm/yr) (Henning et al., 1983; Liu et al., 2003). In this study, we focus on one of the travertine hills in northwest Iran, and discuss the formation age and source of the travertine based on a series of data for ^{14}C, $\delta^{13}C$, $\delta^{18}O$ and major and trace elements.

More than 20 travertine rock samples were collected from the base to the top of a travertine hill in the Takab area, NW Iran. The elevation of the travertine hill is about 60 m. A fault is found near the base of the hill. Several water samples from springs of various sizes (10 cm to 100 m) were collected near the hill in October 2018 and May 2019 to compare the isotope and chemical compositions between the travertine and spring water.

Firstly, ^{14}C concentrations were measured for the travertine rocks and dissolved inorganic carbon (DIC) in the spring water samples by AMS, and $\delta^{13}C$ and $\delta^{18}O$ were determined by IR-MS. Then, major (Ca, Mg) and trace elements (As, Sr, REE, etc.) were analyzed by ICP-MS.

The ^{14}C ages for the travertines range from 42 kBP to 22 kBP. Above the fault, as the elevation increases, the ^{14}C age tends to get younger, but not monotonically. The ^{14}C age of the hill top is 25 kBP. DIC of large spring water has a younger ^{14}C age (18 kBP) than that of small spring water (31 kBP). When we assume that the travertine was precipitated from the small spring like water (31 kBP), we cannot calculate formation age ofn the hill top travertine. Therefore, the large spring water is assumed as the source spring water for the hilltop travertine at the hill top. Based on this assumption and the ^{14}C data, the formation age at the hill top can be estimated as 8–5 ka. In addition, one of the estimation on the growth rate is approximately 5 mm/yr.

The carbon stable isotope compositions ($\delta^{13}C$) is +7 to +12‰, indicating that the travertine is thermogene. Above the fault, the $\delta^{13}C$ value gradually decreases from the base to the top. The $\delta^{13}C$ value at the base (~+10‰) is higher than that at the hill top (~+7‰). So it is assumed that, during the formation of travertine, the travertine spring water type changed from the small spring type water to the large spring type water. In the presentation, we will also discuss data for $\delta^{18}O$ values and major and trace element compositions, possibly indicating paleoclimate and paleotemperature.

Keywords: Travertine, Spring water, 14C age, Oxygen isotope, Carbon isotope

