

Spatial distribution of the He isotope signature in Tachibana Bay. Y. Tomonaga^{1,2}, H. Obata¹, S. Takeda³, N. Takahata¹, and Y. Sano¹, ¹Atmosphere and Ocean Research Institute, The University of Tokyo, Kashiwa, Japan, ²Eawag, Swiss Federal Institute of Aquatic Science and Technology, Dübendorf, Switzerland (correspondence: tomonaga@eawag.ch), ³Nagasaki University, Nagasaki, Japan.

Introduction: Noble gases are powerful tracers to study physical transport processes in aquatic systems. Moreover, helium (He) isotopes have been shown to be very useful to infer the origin of fluids, as three distinct $^3\text{He}/^4\text{He}$ ratios characterize the mantle, the crust, and the atmosphere.

In this contribution we present the results of noble-gas measurements conducted on water samples collected in Tachibana Bay offshore the city of Obama (Japan) and we discuss the potential relationships between our observations, the mixing dynamics of the investigated water body, and the tectonic setup of the surrounding region (Fig. 1).

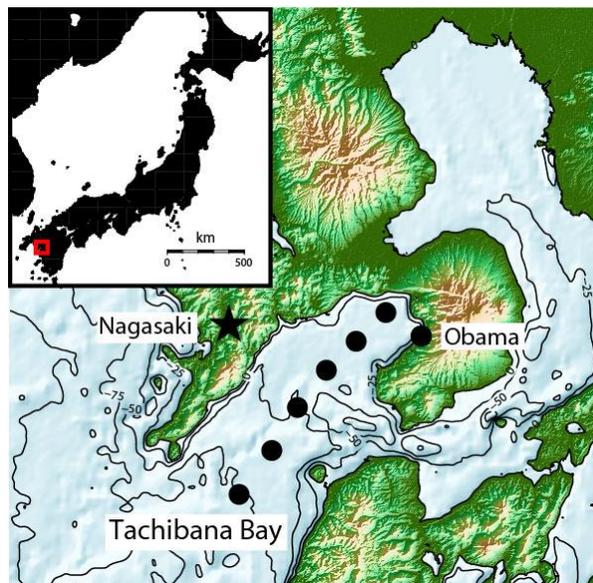


Figure 1: The red square in the inset map highlights the investigated area in Japan. The city of Nagasaki is indicated by a black star. A hydrothermal seepage has been sampled close to the city of Obama. Sampling positions are marked by black dots. The bathymetry contours are plotted every 25 m.

Study site and methods: Tachibana Bay is located in Kyushu (southern Japan) westwards of the Shimabara Peninsula which hosts the Mt. Unzen volcanic group. The east side of the peninsula is confined by Shimabara Bay. Tachibana Bay and Shimabara Bay are connected by the shallow Hayasaki Strait.

We collected water samples for noble-gas analysis close to the seafloor on a NE-SW transect starting from the city of Obama on RV Kakuyou-Maru of the Naga-

saki University. The noble-gas measurements have been conducted at the Atmosphere and Ocean Research Institute (AORI) of The University of Tokyo using a quadrupole mass spectrometer and a Helix SFT mass spectrometer.

Results and discussion: The water within Tachibana Bay is generally characterized by the presence of mantle He. The data suggest both emission of fluids originating from deep geochemical reservoirs and “recycling” recent (ground)water into a geothermal system. The He isotope signature of two bottom water samples acquired at a seepage close to Obama city is enriched in ^3He and seems to be similar to the one of about 4Ra (Ra is the $^3\text{He}/^4\text{He}$ ratio of atmospheric air of $1.38 \cdot 10^{-6}$ [1]) determined by a previous study [2].

The He isotope ratio seems to decrease with increasing distance from Mt. Unzen. A similar pattern in the spatial distribution of the $^3\text{He}/^4\text{He}$ ratios has been observed, for instance, in the case Mt. Ontake (Japan) [3,4]. However, in the light of the limited amount of observational data, at the moment any hypothesis of causality is highly speculative.

Additional ^3He is likely to be provided to Tachibana Bay from Shimabara Bay through the Hayasaki Strait. This is supported by the observation of a strong mantle He emission (up to 8Ra) along the east coast of the Shimabara Peninsula [1] and by the stratification of a colder and less saline water mass in Tachibana Bay coinciding with the depth of the Hayasaki Strait (highlighted by CTD profiles).

References:

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