Paper No. 108-2
Presentation Time: 8:15 AM

EPISODIC RELEASE OF MANTLE-DERIVED FLUIDS ALONG THE PLATE INTERFACE: HELIUM ISOTOPE EVIDENCE AFTER THE TOHOKU-OKI EARTHQUAKE

SANO, Yuji[1], HARA, Takahiro[1], KAWAGUCCI, Shinsuke[2], HONDA, Makio[2], and **HATTORI, Keiko**[3], (1) Atmosphere and Ocean Research Institute, University of Tokyo, Kashiwa-noha, 277-8564, Japan, (2) Japan Agency for Marine-Earth and Technology, 2-15 Natsushima, Yokosuka, 237-0061, Japan, (3) Department of Earth Sciences, University of Ottawa, Ottawa, ON K1N 6N5, Canada, khattori@uottawa.ca

Fluids are essential in subduction zones, including a trigger for partial melting to produce arc magmatism and also for seismic activity; in addition, ore deposits in subduction zones form during hydrothermal activity where fluids transport metals. In a subduction system, fluids together with fluid-mobile metals are incorporated from slabs subducted at the trench, expelled during progressive decent, and discharged through arc volcanoes. Geophysical evidence supports the idea that the interface between subducting and overlying plates are filled with fluids as sediments and slabs release large quantities of water and other volatile elements during their subduction.

The M9.0 Tohoku-oki earthquake in 2011 provided evidence that the movement of fluid during a large earthquake is significantly different from that during quiet periods. The compositions of bottom seawater near the trench have been measured at varying depths since 2007. The record shows steady-state compositions of water with 3He/4He, about ~ 1.15 Ra (Ra= atm. value) before the earthquake, but the value increased sharply to 1.17 -1.19 Ra one month after the earthquake at depths greater than 3500 m. This was accompanied by the release of high ^{13}C methane. The fluid compositions returned to pre-earthquake values ~ 5 months after the event. The locations and timing of high 3He, primordial gas, indicate the release of mantle-derived fluids along the plate interface during the earthquake. The flux of 3He, ~ 1 atom/cm2/sec, is similar to that for the metalliferous hydrothermal activity in the Okinawa back-arc trough. The Tohoku-oki earthquake ruptured the interface between the subducting and overlying plates and produced a co-seismic slip of more than 50 m. The rupture likely increased permeability for the quick release of overpressured fluids from the mantle to the surface. This displacement produced a large tsunami. More than 22 tsunamis have been reported since the 9th century in the area. The deposit related to the AD869 event indicates that the displacement associated with the earthquake was comparable or even larger than that of the 2011 Tohoku-oki earthquake. This suggests that large earthquakes, which are common in subduction zones, likely induce periodic release of fluids and other volatiles from the mantle to the shallow crustal levels

Session No. 108
T103. Fluids, Stress, and Episodicity in Subduction Settings: What We Need to Know
Monday, 28 October 2013: 8:00 AM-12:00 PM

Colorado Convention Center Room 401
Geological Society of America *Abstracts with Programs.* Vol. 45, No. 7, p.0

© Copyright 2013 The Geological Society of America (GSA), all rights reserved. Permission is hereby granted to the author(s) of this abstract to reproduce and distribute it freely, for noncommercial purposes. Permission is hereby granted to any individual scientist to download a single copy of this electronic file and reproduce up to 20 paper copies for noncommercial purposes advancing science and education, including classroom use, providing all reproductions include the complete content shown here, including the author information. All other forms of reproduction and/or transmittal are prohibited without written permission from GSA Copyright Permissions.

See more of: Fluids, Stress, and Episodicity in Subduction Settings: What We Need to Know
See more of: Topical Sessions

<< Previous Abstract | Next Abstract >>

© 2013 • The Geological Society of America