CONTROL ID: 1819527

TITLE: Sulfur, halogens and helium in vesicles and glass of MORB; global fluxes of volatiles from ridges

AUTHORS (FIRST NAME, LAST NAME): Takanori Kagoshima[1], Yuji Sano[1], Naoto Takahata[1], Keiko H Hattori[2], Bernard Marty[3]

INSTITUTIONS (ALL): 1. Atmosphere and Ocean Research Institute University of Tokyo, Kashiwa, Japan.
2. University of Ottawa, Ottawa, ON, Canada.
3. Centre de Recherches Pétrographiques et Géochimiques, Nancy, France.

ABSTRACT BODY: We determined the compositions of vesicles and glasses of MORB to estimate fluxes of S and halogens from ridges to the hydrosphere and atmosphere. Samples were collected at 3 sites of the East Pacific Rise, 3 sites between 15-40 N of the Mid-Atlantic Ridge and 2 sites near 25 S on the Central Indian Ridge. Volatiles were extracted from vesicles by crushing samples in dilute NaOH solution at liq. nitrogen temp. Helium isotope compositions were measured with a VG-5400 MS; S, F and Cl contents with ICS-2100 ion chromatography; and the contents of Br, I and metals with Agilent 7700x ICP-MS. For glass, the concentrations of S, F, Cl and Br were determined with a NanoSIMS.
Vesicles contain similar concentrations of 3He (6.3E-16-5.1E-15 mol/g of sample) and F/Cl molar ratios (0.03-0.15) at all sites. Cl/S ratios are higher at shallower sites, suggesting the start of S degassing at deep levels, > 3000 m. Averages of vesicle data are (4.4±1.3)E7 for S/3He, (1.4±0.7)E6 for F/3He, (2.8±1.3)E7 for Cl/3He, and <2.7E5 for Br/3He and I/3He. The values are much smaller than those for glass probably because of the retention of volatiles in melt at great depths, suggesting that vesicles' contribution of volatiles is minor except for He. Bulk (vesicles+glass) shows S/3He (3.1E9-1.2E10), F/3He (1.6E9-6.5E9), Cl/3He (7.5E8-3.0E9) and Br/3He (5.1E5–2.1E6). Using the global flux of 3He, 527 mol/yr, fluxes of volatiles are calculated to be 2.3E10–6.6E12 mol/yr for S, 7.1E8–3.4E12 mol/yr for F, 1.5E10–1.6E12 mol/yr for Cl and <1.1E9 mol/yr for Br. The values are comparable with those from arc volcanoes reported by Wallace (2005) and Fisher (2008). The combined contributions from MORB and arcs give the total annual fluxes of volatiles to the atmosphere and hydrosphere. Comparison of the annual fluxes and their amounts in the atmosphere and hydrosphere reservoir yield the residence times of volatiles; 4.9E7-1.0E9 yr for S, 2.2E7-5.8E9 yr for F, 1.3E9-1.4E10 yr for Cl, and 1.0E9-8.0E9 yr for Br. These short residence times compared to Earth's age are explained by recycling of volatiles through subduction process.

KEYWORDS: 1032 GEOCHEMISTRY Mid-oceanic ridge processes.

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(No Table Selected)

Additional Details

Previously Presented Material: 0
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Contact Details

CONTACT (NAME ONLY): Takanori Kagoshima

CONTACT (E-MAIL ONLY): kagoshima@aori.u-tokyo.ac.jp

TITLE OF TEAM: