

Mantle carbon and sulfur fluxes in subduction zone

Yuji Sano^{1*}, Takanori Kagoshima¹, Naoto Takahata¹, Teruyuki Maruoka², Tobias Fischer³, Bernard Marty⁴

¹University of Tokyo, ²University of Tsukuba, ³University of New Mexico, ⁴Centre national de la recherche scientifique

Carbon and sulfur dioxide have been discharging for a long time from the Earth's mantle to the atmosphere through volcanic and hydrothermal activity. In contrast to noble gases, they do not accumulate in the atmosphere but are chemically trapped as compounds in oceanic sediment and terrestrial deposits. Some of them may be recycled again into the mantle. Subduction-zone volcanism is a key area to study these volatile transfers to the mantle and/or the recycling. The mantle C flux at mid-ocean ridge (MOR) was assessed from the spreading rate of oceanic plates and their C content [1] and from the MOR-³He flux and CO₂/³He ratio in basalt glasses [2]. On the other hand, the degassing rate at convergent plate margins was estimated by the flux observation in arc volcanoes [3] and the ARC-³He flux and CO₂/³He ratio in volcanic gases [4]. Recently MOR-³He flux has been revised to 530 mol/y by an ocean general circulation model [5], which is about half of the previous value. Based on the new value and argument of global ³He flux [6], ARC-³He flux could be corrected to 110 mol/y. From the literature, we have selected 26 arc volcanic gas and steam well data whose temperatures are higher than 200°C. Their C is well explained by the mixing of three components, MORB, Sediment and Limestone [7]. Since the average CO₂/³He ratio of these data is 1.9±1.0×10¹⁰, ARC-C flux would become 2.1±1.1×10¹² mol/y, which is consistent with 1.9×10¹² mol/y by the most recent estimate [8]. The mantle S flux of 0.1~2.6×10¹¹ mol/y at MOR has been reported by a new experimental crushing and extraction method of MORB [9], which is significantly smaller than the old value of 2.7×10¹² mol/y [10]. On the other hand, the ARC-S flux of 3.15×10¹¹ mol/y was estimated by the SO₂ flux from volcanoes [8]. We discuss here the ARC-S flux based on the ARC-³He flux and SO₂/³He ratio in high temperature volcanic gases.

Reference [1] Javoy et al., 1982. *Nature* **300**, 171-173 [2] Marty and Jambon, 1987. *EPSL* **83**, 16-26 [3] Hilton et al., 2002. *RiMG* **47**, 319-370 [4] Sano and Williams, 1996. *GRL* **23**, 2749-2752 [5] Bianchi et al., 2010. *EPSL* **297**, 379-386 [6] Torgersen, 1989. *Chem Geol* **79**, 1-14 [7] Sano and Marty, 1995. *Chem Geol* **119**, 265-274 [8] Fischer, 2008. *Geochem J* **42**, 21-38 [9] Kagoshima et al., 2012. *Geochem. J.* **46**, e21-e26 [10] Alt et al., 1985. *Init. Rep. DSDP* **83**, 283-287

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