

Air-sea fluxes of dimethyl sulfide and acetone in the subtropical and equatorial Pacific Ocean

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Fluxes of dimethyl sulfide (DMS) and acetone between the ocean and the atmosphere were measured in the subtropical South Pacific Ocean and the equatorial Pacific Ocean in January-February, 2012. Vertical profiles of these gases were obtained above the ocean surface by measurements at 7 heights from 1 to 1400 cm with a profiling buoy aboard R/V Hakuho-Maru during the KH-11-10 and KH-12-1 (EqPOS) cruises. The concentrations of DMS and acetone in gas samples were monitored by a proton transfer reaction-mass spectrometry (PTR-MS). The concentrations of DMS and acetone in the surface seawater and air were continuously measured with PTR-MS during the cruises. The mean sea surface concentration of DMS in the subtropical ocean (2.1 ± 0.5 nM) was slightly lower than that in the equatorial ocean (3.2 ± 1.0 nM). The DMS fluxes substantially varied in the range of 3.6–13.1 and 0.1–18.9 $\mu\text{mol m}^{-2} \text{d}^{-1}$ in the subtropical and equatorial oceans, respectively. The magnitude of DMS fluxes was dependent of wind speed. The gas transfer velocities of DMS were calculated from the fluxes and the seawater DMS concentrations. We will discuss gas transfer velocities in comparison to previous studies. The air-sea fluxes of acetone will be also presented and discussed.

Partitioning of Nb between rutile and NaAlSi₃O₈-, NaCl- and NaF- aqueous fluids at 1-5 GPa and 300-600°C

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Rutile (TiO₂) has been proposed as an important host for high field strength elements (HFSE) such as Nb and Ta in high-pressure, moderate temperature metamorphic environments, including subduction zone systems. The observed depletion of HFSE in arc magmas can be explained if rutile is chemically inert with respect to aqueous fluids evolved during progressive metamorphism of subducted slab materials. However, both field observations and experimental studies [1] suggest that titanium, as well as HFSE can be soluble in aqueous fluids. Published experimental data were obtained by performing experiments at temperatures >700°C and pressures <2.5 GPa, conditions not entirely relevant to fluid loss in many arc systems. Here, we report new data that constrain directly the partitioning of Nb between fluid and rutile at 1 to 5 GPa and 300-600°C, conditions applicable to fluid evolution during the blueschist to eclogite transition.

We investigated systematically the partitioning of Nb between aqueous fluid and Nb-rutile (1wt% Nb) by adding albite (NaAlSi₃O₈), 10 and 20 wt % NaCl, and 4 wt % NaF to the fluid phase. The concentration of Nb in aqueous fluid was measured directly by using a hydrothermal diamond anvil cell and synchrotron X-ray fluorescence at the HPCAT 16-IDD beamline at the Advanced Photon Source.

Fluid	Pressure (GPa)	Temperature (°C)	Nb Concentration (ppm)
10% NaCl	1.2-2.8	300-700	9-23
20% NaCl	1.7-4.7	300-600	24-86
NaAlSi ₃ O ₈	1.0-5.8	300-600	100-1050
4% NaF	3.0-6.5	300-500	260-1075

Our data indicate that dissolved NaF and albite, relative to pure water and NaCl, have a much greater effect on enhancing Nb concentration and transport in dense, moderate temperature, aqueous fluid. Our findings are consistent field studies such as [1] that document HFSE mobility in aqueous fluids evolved during the blueschist to eclogite transition.

[1] Gao *et al.* (2007) GCA, 71, 4974-4996.