Polar Science NiPR ELSEVIER

The followings are published in Vol.3(1).

Tidal gravity variations revisited at Vostok Station, Antarctica

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In 1969, prior to the discovery of the subglacial Lake Vostok, an Askania Gs-11 gravimeter was operated at Vostok Station (78.466° S, 106.832° E; 3478 m asl) to observe tidal gravity variations. To gain a better understanding of the lake's tidal dynamics, we reanalyzed these data using Bayesian Tidal Analysis Program Grouping method (BAYTAP-G and -L programs). The obtained phase leads for the semidiurnal waves M2 (6.6 ± 2.1°) and S2 (10.1 ±4.2°) are more pronounced than those of the diurnal waves, among which the largest phase lead (for K1) was 5.0 ± 0.5° . The obtained δ factor for M2 was 0.890 ± 0.032, significantly less than the theoretical value of 1.16. For three global ocean tide models (NAO99b, FES2004, and TPXO6.2), the estimated load tides on waves Q1, O1, P1, K1, M2, and S2 range from 0.1-0.2 μGal (Q1 and S2) to 0.6-0.7 μGal (K1). The difference in amplitude among the three models is less than 0.14 μGal (M2), and the difference in phase is generally less than 10° . In calculating the residual tide vectors using the ocean models, the TPXO6.2 model generally gave the smallest residual amplitudes. Our result for the K1 wave was anomalously large (1.36 ± 0.25 μGal), while that for the M2 wave was sufficiently small (0.37 ± 0.17 μGal). The associated uncertainty is half that reported in previous studies. It is interesting that the residual K1 tide is approximately 90° phase-leaded, while the M2 tide is approximately 180° phase-leaded (delayed). Importantly, a similar reanalysis of data collected at Asuka Station (71.5° S, 24.1° E) gave residual tides within 0.2-0.3 μGal for all major diurnal and semidiurnal waves, including the K1 wave. Therefore, the anomalous K1 residual tide observed at Vostok Station must be linked to the existence of the subglacial lake and the nature of solid-ice-water dynamics in the region.

Upper-Ocean Hydrodynamics along near-Meridional Sections in the Southwest Indian Sector of the Southern Ocean during Austral Summer 2007

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This paper addresses analysis of surface meteorological and hydrographic data collected along the transects Durban —India Bay, Antarctica (Track-1) and Prydz

Bay — Mauritius (Track-2) during February—March 2007 as part of the International Polar Year project (IPY#70). Strong winds (>12 m s^{-1}) resulted in enhanced turbulent heat loss north of 45° S. Whereas a highly stable marine atmospheric boundary layer (MABL) and strong winds facilitated the release of latent heat of condensation along Track-1, a highly unstable MABL and strong winds resulted in large turbulent heat loss from the sea surface along Track-2, in the 40—45° S belt. The northern and southern branches of Subantarctic Front on both tracks coalesce, while the Agulhas Retroflection Front (AF) and South Subtropical Front (SSTF) merge between 43° and 44° S on Track-2. The southern branch of the Polar Front (PF2) meanders 550 km southward towards the east. The Subtropical Surface Water, Central Water, and Mode Water are located north of 43.5° S, while the Subantarctic Surface Water, Antarctic Surface Water, Antarctic Intermediate Water, and Circumpolar Deep Water are encountered in the region of the Antarctic Circumpolar Current (ACC). Baroclinic transport relative to 1000 db reveals that the ACC is enhanced by 10×10^6 m^3 s^{-1} eastward, and a four-fold increase in transport occurs south of the ACC. Nearly 50% of the ACC transport occurs in the 100—500 m slab. We discuss the effects of the feedback of AC and hydrological fronts on the MABL.

High temperature annealing of amoeboid olivine aggregates: Heating experiments on olivine-anorthite mixtures.

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Amoeboid olivine aggregates (AOAs) are composed of forsteritic olivine, Fe,Ni-metal, and Ca,Al-rich nodules consisting mainly of Al-diopside, spinel, and anorthite. Although the textures, shapes, and mineralogy of AOAs are consistent with their being aggregates of nebular condensates, some textures are in conflict with equilibrium condensation calculations, indicating that AOAs were not produced by a simple one-stage condensation. To examine the origin of the constituent minerals within AOAs and their textural relationships, we performed heating experiments using mineral mixtures analogous to those in AOAs. Isothermal and cooling experiments on forsterite + anorthite mixtures reveal that a high-Ca pyroxene phase forms via the incipient melting of the two minerals. Comparative studies of heating experiments performed using the mineralogy of AOAs suggest that Al-diopside in AOAs can be produced from a small degree of melting of forsterite and anorthite. The formation of Al-diopside in this way is consistent with the annealing textures observed in AOAs, and it may account for the discrepancy between the observed mineralogy of AOAs and the results of equilibrium condensation calculations, the occurrence of two types of diopside (Al,Ti-rich diopside and Al-diopside), and the variable Al_2O_3 content of Al-diopside.

Diel tuning of photosynthetic systems in ice algae in Saroma-ko Lagoon, Hokkaido, Japan.

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Ice algae are the major primary producers in seasonally ice-covered oceans during the cold season. Diurnal change in solar radiation is inevitable for ice algae, even beneath seasonal sea ice in lower-latitude regions. In this work, we focused on the photosynthetic response of ice algae under diurnally changing irradiance in Saroma-ko Lagoon, Japan. Photosynthetic properties were assessed by pulse-amplitude modulation (PAM) fluorometry. The species composition remained almost the same throughout the investigation. The maximum electron transport rate (*rETR*max), which indicates the capacity of photosynthetic electron transport, increased from sunrise until around noon and decreased toward sunset, with no sign of the afternoon depression commonly observed in other photosynthetic organisms. The level of non-photochemical quenching, which indicates photoprotection activity by dissipating excess light energy via thermal processes, changed with diurnal variations in irradiance. The pigment composition appeared constant, except for xanthophyll cycle pigments, which changed irrespective of irradiance. These results indicate that ice algae tune their photosynthetic system harmonically to achieve efficient photosynthesis under diurnally changing irradiance, while avoiding damage to photosystems. This regulation system may be essential for productive photosynthesis in ice algae.

Influence of thin liquid films on polar ice chemistry: implications for Earth and planetary Science

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The polar snowpack (and sea-ice) plays a major role in affecting overlying boundary layer chemistry and has only recently come to light. Furthermore, the understanding of this system and its importance is steadily growing. Investigations done thus far, nonetheless, examined the subsets of the polar environment as an uncoupled system. Analogous to some materials, the surface of snow/ice exhibits thin liquid layers (e.g., the quasi-liquid layer (QLL) and brine layer (BL). This paper gives an overview of thin liquid films and illustrations of their function in Earth science. The impact of such films in polar science (i.e., polar snowpack photochemistry) is discussed within the context of how field data has been elucidated through laboratory data and modeling techniques. Specifically, what laboratory and modeling investigations have revealed about the effect of thin liquid layers on constraining field observations and, more importantly, the physicochemical mechanisms that govern the behavior of trace gases within the snowpack (and sea-ice) and how they are released from the polar snowpack. Current and future impacts of these findings

are discussed, along with putative implications of the effect of thin liquid films in planetary science.