# Glacial-interglacial cycles of the atmospheric $pCO_2$: Effects of physical change in the ocean

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It is well known that, at the Last Glacial Maximum (LGM), the atmospheric $CO_2$ pressure, $pCO_2$ hereafter, was 80-100 ppm lower than the pre-anthropogenic value. We have performed some numerical experiments by using an ocean general circulation model (OGCM) coupled with biogeochemical processes to evaluate quantitatively the effects of changes in various conditions upon an oceanic carbon cycle and $pCO_2$.

We have investigated the effect of various changes in physical conditions of ocean (the circulation field, temperature, salinity, and the sea-ice extent) on $pCO_2$ by numerical experiments. We consider several model-ocean physical-fields which are based on reproduction by an atmosphere-ocean coupled general circulation model (MIROC3.2). We found that, if a LGM physical ocean field reproduced by MIROC3.2 was assumed, $pCO_2$ was lowered by ~30 ppm compared to the interglacial value. Most of the 30 ppm reduction can be explained by higher solubility of $CO_2$ into the ocean due to the glacial lower sea-surface temperature. In particular, the reduction in sea-surface temperature in the North Atlantic had a greatest effect. On the other hand, the effect of change in the circulation was small. This would be because the variation in physical $CO_2$ transport to the deep ocean and biological counterpart induced by the circulation change would offset each other. We also found that the effect of sea-ice expansion in the Southern Ocean was trivial resulting in only a several ppm reduction in $pCO_2$ (also see [1]). Furthermore, if we assumed other model ocean physical fields, the effect of the solubility change was still dominant.

[1] Kurahashi-Nakamura *et al.* (2007) *Geophys. Res. Lett.* **34**, L20708, doi:10.1029/2007GL030898.

# Geochemistry and geochronology of Gaima Basaltic Lava Plateau, Northeast China

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We report comprehensive data set of major and trace element compositions, Sr, Nd and Pb isotopic compositions, and K-Ar ages of the Gaima basaltic lava plateau in Changbaishan area, northeast China. The lava plateau has been formed as intraplate volcanism on the Sino-Korean Paraplatform since Cenozoic time, and Tianchi Volcano is now active on the plateau.

Rock samples used in this study were collected mainly from the northern and the western part of the lava plateau. All samples are basaltic in composition, but the $K_2O$ contents are various, ranging from 0.5 to 2.5 wt.%. The trace element concentration pattern of the lavas is characterized by positive spikes of Ba and Pb. The isotopic compositions are relatively homogeneous, falling within the ranges of $^{87}Sr/^{86}Sr$ = 0.7048-0.7055, $^{143}Nd/^{144}Nd$ = 0.5125-0.5126 and $^{206}Pb/^{204}Pb$ = 17.4-17.8, and are similar to those reported by Basu *et al.* [1]. The K-Ar ages of the studied samples (n=13) range from 0.5 to 4.2 Ma, except for one sample (20.7 Ma). The result of the age daging indicates that some activities of the northern and western Gaima plateau were contemporaneous with the formation of the Tianchi basalt shield (<2.8 Ma; [2]).

No significant spatial variation of the geochemical features is found. On the other hand, weak temporal variations are observed, and it seems that Sr and Pb isotopic ratios tend to become more various from ~4 Ma to ~0.5 Ma. The variations might have resulted from gradual changes of mantle processes due to the transition of tectonic environment from extensional to compressional at ~3 Ma [3].

[1] Basu *et al.* (1991) *Earth Planet. Sci. Lett.* **105**, 149-169. [2] Wei *et al.* (2007) *Lithos* **96**, 315-324. [3] Wang *et al.* (2003) *J. Asian Earth Sci.* **21**, 1159-1170.