Geophysical Research Abstracts
Vol. 12, EGU2010-11080, 2010
EGU General Assembly 2010

10Be in ice - four decades, two ice sheets, 15 deep coring sites

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Over the last few decades, numerous studies of ^{10}Be in ice cores from Antarctica and Greenland have comprised a significant source of information on climate, solar activity and geomagnetic field intensity over the past 800 000 years. There is, however, a large variability in the available ^{10}Be records in terms of resolution and time coverage. We here present a comprehensive summary of results that have been put forward since the 1960s. Marine sediment was the first type of natural archive in which ^{10}Be was detected (Arnold, 1956), and a decade later McCorkell et al. (1967) pioneered the ice archive field by counting ^{10}Be beta activity in samples from Camp Century, Greenland. The method demands a large amount of material; in this case 1.2×10^6 litres of water were used. Using accelerator mass spectrometry, AMS, Raisbeck et al. (1978) undertook the second study of ^{10}Be in polar ice, measuring ^{10}Be concentrations in ice from Dome C, Antarctica. The AMS technique is exclusively used today for measurements of ^{10}Be in small ice volumes (<1 liter). Subsequent ^{10}Be studies have exposed many details relating to paleoclimate changes, such as lower ^{10}Be concentrations during the Holocene compared to the last glacial period, a pattern that correlates to δ^{18}O records, and this is often attributed to lower snow accumulation rates during the glacial period (e.g. Raisbeck et al., 1981; Beer et al., 1983; Yiou et al., 1985). Similarly, during the last glaciation higher ^{10}Be concentrations generally correspond to more negative δ^{18}O values over millennial timescales, although correlation to snow accumulation rates is limited to periods of large climate change, such as the Younger Dryas (e.g. Finkel and Nishiizumi, 1997). During the Holocene, no clear correlations between ^{10}Be and δ^{18}O variations are observed (e.g. Beer et al., 1987). Production rates of cosmogenic isotopes are influenced by solar activity and geomagnetic field intensity, and variations in these factors have been traced through measurements of ^{10}Be in ice cores. One example of this is solar Schwabe cycle variations which have been identified in ^{10}Be variations in ice from Milcent, Greenland (e.g. Beer et al., 1985). Further, geomagnetic excursions have introduced peaks and troughs in ^{10}Be concentrations, which along with production variation patterns may aid in age determination and time scale calibration (e.g. Beer et al., 1987; Raisbeck et al., 2006). ^{10}Be data has also been applied in reconstructions of past geomagnetic field intensity variations (e.g. Wagner et al., 2000). Recent data by Berggren et al. (2009) show agreement of ^{10}Be deposition at two Greenland sites, although local differences occur on an annual basis. Future investigations of ^{10}Be in ice cores may concentrate on evaluating local versus regional variations and separate the effects of deposition variability from production rate changes.

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