A 12,000 year record of explosive volcanism in the Siple Dome Ice Core, West Antarctica

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[1] Air mass trajectories in the Southern Hemisphere provide a mechanism for transport to and deposition of volcanic products on the Antarctic ice sheet from local volcanoes and from tropical and subtropical volcanic centers. This study extends the detailed record of Antarctic, South American, and equatorial volcanism over the last 12,000 years using continuous glaciochemical series developed from the Siple Dome A (SDMA) ice core, West Antarctica. The largest volcanic sulfate spike (280 μg/L) occurs at 5881 B.C.E. Other large signals with unknown sources are observed around 325 B.C.E. (270 μg/L) and 2818 B.C.E. (191 μg/L). Ages of several large equatorial or Southern Hemisphere volcanic eruptions are synchronous with many sulfate peaks detected in the SDMA volcanic ice chemistry record. The microprobe "fingerprinting" of glass shards in the SDMA core points to the following Antarctic volcanic centers as sources of tephra found in the SDMA core: Balenny Island, Pleiades, Mount Berlin, Mount Takahe, and Mount Melbourne as well as Mount Hudson and possibly Mount Burney volcanoes of South America. Identified volcanic sources provide an insight into the poorly resolved transport history of volcanic products from source volcanoes to the West Antarctic ice sheet.

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1. Introduction

[2] As has been documented previously [e.g., *Hammer et al.*, 1980; *Robock and Free*, 1995; *Zielinski*, 2000; *Mosley-Thompson et al.*, 2003], volcanic records recovered from ice cores drilled from the polar regions provide the best means to evaluate the impact of volcanism on global climate [*Robock*, 2000]. Continuous long-term records of SO_4^{2-} concentrations [*Mayewski et al.*, 1986, 1997; *Legrand et al.*, 1988; *Mosley-Thompson et al.*, 1991; *Delmas et al.*, 1992; *Zielinski et al.*, 1994, 1996b; *Langway et al.*, 1995; *Cole-Dai et al.*, 1997; *Jouzel et al.*, 2001; *Stenni et al.*, 2002; *Castellano et al.*, 2004, 2005], total acidity records from electrical conductivity (ECM) [*Hammer et al.*, 1980; *Hammer*, 1983; *Taylor et al.*, 1993; *Taylor and Alley*, 2004; *Wolff et al.*, 1995; *Clausen et al.*, 1997; *Karlöf et al.*, 2000], and dielectric profiling (DEP) [*Moore et al.*, 1989; *Udisti et al.*, 2000] methods detect the presence of volcanically produced aerosols and can be used to estimate the atmospheric loading of H_2SO_4, the primary climate-forcing component of an eruption [*Self et al.*, 1981; *Rampino and Self*, 1982, 1984; *Zielinski*, 1995]. These same records improve the overall chronological record of global volcanism [e.g., *Simkin and Siebert*, 1994]. Furthermore, these robust records provide a means to evaluate the volcano-climate system under different climatic modes than presently exists, and they provide critical information on how the type or frequency of eruptions may impact climatic conditions. The climatic impact of both multiple eruptions closely spaced in time and megaeruptions (e.g., Toba eruption of approximately 75,000 years ago [*Ninkovich et al.*, 1978; *Rose and Chesner*, 1987; *Zielinski et al.*, 1996a; *Oppenheimer*, 2002]) also may be different. However, deficiencies remain in the information currently available from existing ice core records of volcanism and the continued collection of highly resolved lengthy records from both Greenland and Antarctica remains a high priority for attaining a complete understanding of the volcanism-climate system. Spatial variability in the timing and magnitude of volcanic signals among cores also dictates that additional ice cores be evaluated, thereby increasing the confidence in estimates of atmospheric loading from past volcanic eruptions. The volcanic record that we present from the Siple Dome A ice core (hereafter SDMA), West Antarctica (Figure 1) is a contribution to solving some of these problems.

[3] Deficiencies in the ice core volcanic records available from the two polar regions are a function of several factors. One key factor is the temporal nature of the existing ice core derived volcanic record from Antarctica. Available annually

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