

# Volcanic eruptions and solar activity detected in ice core

THE DEEP ICE CORE EXTRACTED FROM DOME Summit South (DSS) at Law Dome (120 km from Casey station) provides a climatic and environmental record extending back over eighty thousand years, well into the last ice age. The DSS drill site has a very high snow accumulation rate by polar standards (equal to approximately 64 cm of water per year), making the record particularly detailed.

Recent analysis of trace chemicals in the ice at approximately monthly resolution has provided precise timing of more than a dozen major global volcanic events over the past 700 years, and also revealed subtle signals of 17 solar events in the past 112 years.

Solar activity and volcanic eruptions both are natural mechanisms for climate. Proxies of these, such as the ice core chemical markers described here, are important keys for understanding how much of the observed climate variations today are attributable to human influence.

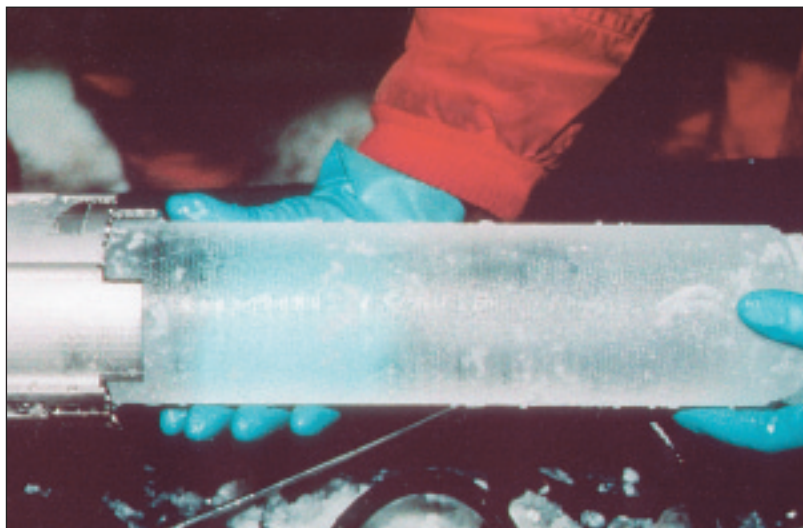
## Volcanic signal

Major volcanic eruptions eject large quantities of dust and fine aerosols into the atmosphere. Some of the aerosols find their way into the stratosphere where they can persist for several years, producing the spectacular sunsets familiar to many following the Mt Pinatubo eruption in 1991. These aerosols influence climate by reducing the amount of sunlight that reaches the Earth's surface. Eventually, depending on the location of the eruption and prevailing atmospheric conditions, the chemicals from the aerosols (principally sulphate) find their way into precipitation, increasing the acidity slightly. It is this increase in sulphate levels that can be detected in the ice core.



*Drilling operations at the DSS site.*

VIN MORGAN



*The deepest ice core (1200 metres) extracted from the DSS site.* VIN MORGAN

The Law Dome ice core shows that the lag between eruptions and the arrival of detectable fallout varies from 10 months to 2.5 years for 10 well-dated eruptions. It also shows a very large eruption in about 1459 (the largest sulphate producer in the 700-year record). An event around this time had been recorded in other ice cores, but with less precision. Historical and tree-ring records, suggested an event in 1453 which is thought to be the eruption of the volcano Kuwae in Vanuatu. Even with the variation in transport time and general dating uncertainties, the DSS ice core signal cannot be made to match an eruption much earlier than 1456, and so an interesting puzzle is emerging. The matter is of more than academic interest, because large events like this tend to be used to tie the dating in records from a wide range of sources.

## Solar signal

The solar activity signal in the DSS core shows as increases in nitrate following solar outbursts called solar proton events. Nitrate is one of the more poorly understood major atmospheric chemicals, but theoretical calculations have pointed to the potential for production by solar proton events. In fact, some ice core studies have reported large nitrate spikes, which have been tied to solar events, but other studies have failed to find any connection at all. The Law Dome result is significant because it uses the good dating control in this core to search for, and detect, nitrate elevation following 17 known solar events.

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