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Tephrostratigraphy of the EPICA-Dome C ice core (East Antarctic plateau): implications for long-distance stratigraphic correlations and ice core dating

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Volcanic ash (tephra) layers sometimes preserved in polar ice cores represent time-synchronous horizons that enable precise stratigraphic correlations of records across wide regions, even between different depositional environments. When correlated with dated volcanic deposits in the source area, they may also provide useful information on age and help refine ice timescales from glaciological models.

The last 200-kyr section of the EPICA-Dome C (EDC) ice core (75˚06' S, 123˚21' E) contains thirteen airfall tephra layers with substantial amount of juvenile vitreous material. These layers are up to 36 mm thick, and display average glass shard size of a few tens microns. Comparison of tephra geochemical signatures to the rock composition of Quaternary volcanic centres located within and around Antarctica indicate that five EDC layers originate from South Sandwich volcanoes, two from South Shetland volcanoes, two from Andean volcanoes, and four from Antarctic (Marie Byrd Land and Melbourne) provinces.

Based on the chemical fingerprinting of tephra layers, we established several stratigraphic correlations between the EDC climatic record and those in the Vostok and Dome Fuji deep ice cores. These independent depth-to-depth links provide reliable tools for evidencing climatic differences among the sites. The resulting regional tephrostratigraphic framework offers the potential for extending correlations to other Antarctic ice cores and to sediment climatic archives of the circum-Antarctic regions.

In addition, we used chronostratigraphic information and geochemical data to suggest that a tephra layer from the EDC and Dome Fuji ice cores is the distal counterpart of the Mt. Berlin (Marie Byrd Land province, West Antarctica) pyroclastic unit $^{40}Ar/^{39}Ar$ dated to 92.5$\pm$2.0 and 92.2$\pm$0.9 kyr. This suggested correlation may provide independent time constraints for glaciological modelling of core chronology.