Geochemical correlation of marine tephra from Sulu to proximal deposits of active volcanoes in the Philippines

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The study of tephra deposited in the deep sea is important because they provide information on the scale and style of large eruptions, aside from providing samples that would not normally be preserved on land. Sulu Sea, a marginal basin west of the Philippines, is in the downwind direction of several volcanic chains and is a sink for tephra deposits of explosive volcanism. Tephra layers preserved in the Sulu Sea cores taken during the 2006 Marco Polo II cruise were studied to determine their possible source volcanoes using geochemistry. Seven ash layers were identified at 37 to 450 cm depth of the core. Highly vesiculated glass fragments with bubble wall structures were obtained from the ash intervals. The glass fragments were analyzed by EPMA for major elements. Trace elements were obtained by single grain in-situ laser ablation for onland samples and by SIMS for core samples. The glasses from the thicker, light-colored ash layers are rhyolitic (67-77 SiO2 wt%), those from the thinner, darker ash layers are andesitic to dacitic (52-66 SiO2 wt%). The geochemistry of ash layers were compared with samples taken from land deposits of known explosive eruptions. Data for ash layers and land deposits formed relatively tight clusters on incompatible element discrimination diagrams, implying an eruptive rather than turbidite origin for all ash layers except one at 337 cm. Onland tephra showed enrichment in light rare earth elements with a positive Ce anomaly, whilst the marine tephra were observed to have enrichment in the heavy rare earth elements. Detailed inspection of the trace element data reveal that the rhyolitic ash layers may have an affinity with Bulusan volcano deposits whereas the basaltic-andesitic layers have similar composition with those of younger Mayon airfall deposits. While several layers preserved in the core appear to be cogenetic and related to a specific source volcano, others still require distinct sources from those already identified in this study. Alternatively, they may reflect variations in the source volcano magma compositions which are not preserved on tephra deposits onshore.