Volcanic and compositional evolution of Nemrut stratovolcano over ca. 550,000 years as reflected on land and in tephra layers drilled into adjacent huge Lake Van (Eastern Anatolia)

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We have analyzed the evolution of explosive volcanism (stratigraphy, volcanology, composition) of a large, previously poorly studied stratovolcano by studying both land deposits and several hundred tephra layers drilled at Lake Van, the largest saline lake in the world (130 km WSW-ENE extent, max. depth 450 m). One of our aims is to reconstruct the evolution of one or more theoretical stratovolcano based entirely on the tephra layers drilled in 2010 in the ICDP PaleoVan project - pretending the source to be unknown. This model is then compared with the tephra studies of two real volcanoes: Historically active alkalic Nemrut (2,948 m asl), famous for its caldera, rises west and neighboring calcalkalic larger Suphan (4,058 m asl) north/northeast of Lake Van. This approach should aid in reconstructing volcano evolution based entirely on drill data. Another goal is to understand the interaction of climate - paleoclimate being the rationale of the Paleovan project - volcanism and tectonism, the Van basin being located in the collision zone between the Arabian and Eurasian plates.

We have recognized ca. 40 variably peralkaline trachytic and rhyolitic fallout tephra units on land, some of large magnitude (up to ca. 30 km^3 DRE), and ca. 12 slightly welded and slightly more mafic ignimbrites. Rhyolitic activity increased strongly during the past 200 ka, major eruptions occurring in intervals of 20-40,000 years. Axes of major fallout fans are oriented dominantly west-southwest, the main reason for the dominance of Nemrut-sourced tephras in the cored section. Basaltic tephras are next to absent.

Results from drilled tephra deposits: (1) Explosive eruptions began ca. 550,000 years ago dominantly from nearby sources. (2) Calcalkalic dacite-rhyolite tephras are more common among older tephras while the upper ca 100 m of the 220 m cored section are almost exclusively peralkaline trachyte and rhyolite. (3) Basaltic tephra is common in the lower ca. 80 m (older than ca. 400 ka), common sideromelane shards indicating subaqueous eruption. Basaltic eruptions dominantly occurred at low altitudes possibly also in the early lake stage. (4) Fallout tephras dominate but ca. 10-12 thicker (up to 6 m) and poorly sorted tephras are interpreted as syn-ignimbrite turbites suggesting several caldera stages. (5) The overall volcanic evolution began with a dominantly basaltic stage accompanied by 2 or more explosive volcanoes, beginning with the calcalkalic one. (6) Compositions changed significantly, the calkalkalic center prevailing early, the alkalic later. (7) At least 2 different centers are involved because of lack of overlap in mineralogy and bulk chemistry (fayalite, hedenbergite, sporadic aenigmatite, anorthoclase in the alkalic volcano and plagioclase, hypersthene, clinopyroxene and olivine all in partial disequilibrium in the calcalkalic center). (8) The alkalic volcano was either much larger (more active), younger or located more upwind than the calcalkalic one.