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Zircon Chemistry and chronostratigraphy of tephras: case of Cappadocia

L. Akin (1), E. Aydar (1), A. K. Schmitt (2), and H. E. Çubukçu (1)

(1) Hacettepe University Department of Geological Engineering, Beytepe, Ankara, 06800, Turkey, (2) Department of Earth and Space Science, University of California, Los Angeles, 595 Charles Young Dr., Los Angeles, CA, 90095-1567, USA

Zircon is a robust mineral resistant to alteration and post-magmatic heating and hence can be used as a reliable chronometer for dating its crystallization in magmas. We employed zircon geochemistry (trace elements, oxygen isotopes) to correlate ignimbrites with close eruption ages that cannot be easily resolved by 40Ar/39Ar geochronology. Zircon methodology has been applied to 9 different ignimbrite successions of Miocene-Pliocene in Central Anatolian Volcanic Province (Turkey).

These large scale rhyodacitic to ryholitic ignimbrites (namely Kavak, Zelve, Sarımadentepe, Sofular, Cemilköy, Tahar, Gördeles, Kızılkaya, Valibabatepe) cover nearly 20.000 km2. These extensive pyroclastic deposits are formed in continental settings. These deposits are intercalated with fluvio-lacustrine sediments and local lava flows originating from various volcanic centers in the region. 206Pb/238U zircon crystallization ages for each ignimbrite unit, except Valibabatepe, due to lack of zircon, are determined. For the oldest ignimbrites Kavak, Zelve, Sarımadentepe and Sofular units 206Pb/238U zircon ages are c. 10-8 Ma. The average zircon ages obtained from Cemilköy, Gördeles, Tahar and Kızılkaya ignimbrites zircon ages are 7-5 Ma. These ages are consistent with their stratigraphic positions and 40Ar/39Ar ages (Aydar et al., 2012).

206Pb/238U zircon crystallization ages with zircon trace elements (U, Ti, Y, Hf) and oxygen isotopes yield absolute chronostratigraphy of Miocene-Pliocene ignimbrites. For Kavak and Zelve, we determine close compositional existence (U/Y average: 0.46 and 0.48) and δ18O values. Moreover, for Sarımadentepe and Sofular ignimbrites, although zircon ages and zircon trace elements (U/Y average: 0.21 and 0.24) are similar, δ18O values reveal the differences between both units. We also acknowledge that the local air fall deposits, which have not been associated to any ignimbrite, share the same magmatic source with Cemilköy ignimbrite according to δ18O values and zircon trace element compositions (U/Y average: 0.44, 0.52, 0.54 for local air fall deposits and 0.48 for Cemilköy). We successfully established the tephra chronostratigraphy with close eruption ages by applying zircon chemistry and 208Pb/238U ages. Zircon geochemistry can be used as a promising tool for tephra correlation and chronostratigraphy.