Chemie der Erde xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Chemie der Erde

journal homepage: www.elsevier.com/locate/chemer

Mineralogical and petrological features of the Cemilköy ignimbrite, Cappadocia, Turkey

Gullu Deniz Dogan-Kulahci[a,*], Abidin Temel[a], Alain Gourgaud[b]

[a] Hacettepe University, Department of Geological Engineering, 06800, Beytepe, Ankara Turkey
[b] Blaise Pascal University, UMR-CNRS 6524, Campus Universitaire des Cézeaux, 6 Avenue Blaise Pascal, TSA 60026, CS 60026, 63178 Aubiere Cedex France

ARTICLE INFO

Keywords:
Cappadocia
Cemilköy ignimbrite
Mineralogy
Petrology
Geochemistry
Plagioclase geothermometer

ABSTRACT

The Cemilköy ignimbrite is one of the voluminous ignimbrite deposits in Cappadocia. The Cemilköy ignimbrite contains pumice and lithic clasts of volcanic and ophiolitic origin in an ash matrix. The unwelded Cemilköy ignimbrite is distinguished from other deposits in Cappadocia by flattened pumices, elongate vesicles and a slaty fabric. The mineral assemblage of the Cemilköy ignimbrite is plagioclase, biotite, quartz and oxides (magnetite and Ti-magnetite) and the matrix is glassy. Eutaxitic texture is dominant and all pumice clasts have a vitrophyric-porphyritic texture. The same textural properties were observed throughout the spatial distribution of Cemilköy ignimbrite. Microprobe studies reveal that plagioclase compositions range from albite through oligoclase-andesine. Estimated plagioclase-liquid temperatures (T) and pressures (P) are varying between 806 and 847 °C and 4.2–7.1 (kbar), and the H_2O content of the melt is estimated to have been 5 wt.% from the pumice clasts. Based on geochemical data, the Cemilköy ignimbrite is rhyolitic and calc-alkaline in character, and all pumice clasts are enriched in LIL and LRE elements relative to HFS elements. Negative Nb, Ta and Ti anomalies, ratios of Ba/Nb > 28 (56–77), Ba/Ta >450 (590–700) and Th/Yb vs. Ta/Yb are consistent with a subduction-related origin. According to the geochemical and mineralogical-petrographical data, the Cemilköy ignimbrite originated from partial melting of a mantle source which was enriched during previous subduction processes with variable degrees of assimilation fractional crystallization (AFC) through time and Cemilköy ignimbrite erupted from a crustal magma chamber at shallow to intermediate depth.

1. Introduction

Central Anatolia is located between the convergent Afro-Arabian and the Eurasian plates. The tectonic regime changed as a result of the collision of the Eurasian and Afro-Arabian plates in the Middle (Early) Miocene, and widespread volcanism developed after collision (Şengör, 1980; Şengör and Yılmaz, 1981). As a result, the Anatolian micro-plate extruded to the west along two major strike-slip faults, the North Anatolian Fault and the East Anatolian Fault (Fig. 1a). This movement was accomplished by formation of pull-apart basins (e.g. Sultansazlığı, Tuzgölü) (Fig. 1b) and thrust-faults (Şengör et al., 1985; Kempler and Garfunkel 1991; Lyberis et al., 1994). Anatolian Cenozoic tectonics were also characterized by subduction along the Cyprus trench, and an associated extensional tectonic regime (Faccenna et al., 2003; 2006; Biryol et al., 2011). Temel et al. (1998) also stated that from Miocene to Quaternary, decreasing $^{87}Sr/^{86}Sr$ (i) ratio of ignimbrites may be linked with the transition from collisional to extensional tectonics. The Central Anatolian Volcanic Province (CAVP) (Toprak and Göncüoğlu, 1993) is one of the major Cenozoic volcanic provinces in Cappadocia (Turkey). The CAVP consists of numerous basaltic and rhyolitic monogenetic vents, stratovolcanoes and extensive ignimbrite deposits (Aydar and Gourgaud, 1998). From Miocene to Quaternary, volcanism in Central Anatolia (Cappadocia) occurred between the Sultansazlığı and Tuzgölü basins, and is mainly characterized by the coexistence of transitional-type alkaline and calc-alkaline volcanism (Aydar et al., 1995). Based on the geological and geophysical studies, Quaternary volcanism in the CAVP was controlled by major strike-slip and local extensional faults (Alıcı Şen et al., 2004; Aydar and Gourgaud 1998; Bozkurt 2001). Two concealed caldera complexes exist, Derinkuyu and Acıgöl (Le Pennec et al., 1994; Froger et al., 1998) (Fig. 1b).

Several researchers focused on the geological, geochronological and geochemical features of the CAVP (e.g., Pasquare, 1968; Innocenti et al., 1975, 1982; Pearce et al., 1990; Schumacher et al., 1990; Temel 1992; Schumacher and Mues-Schumacher, 1996; Temel et al., 1998; Le Pennec et al., 1994; Le Pennec et al., 2005, Kuşçu-Gençalioğlu and Geneli, 2010; Schmitt et al., 2011, 2014; Aydar et al., 2012; Paquette and Le Pennec, 2012; Aydın et al., 2014; Gencoglu Korkmaz et al., 2017). Later papers offered significant contributions about the

* Corresponding author.
E-mail addresses: gdeniz@hacettepe.edu.tr, gdenizd@gmail.com (G.D. Dogan-Kulahci).

https://doi.org/10.1016/j.chemer.2017.11.002
Received 11 August 2016; Received in revised form 16 July 2017; Accepted 7 November 2017

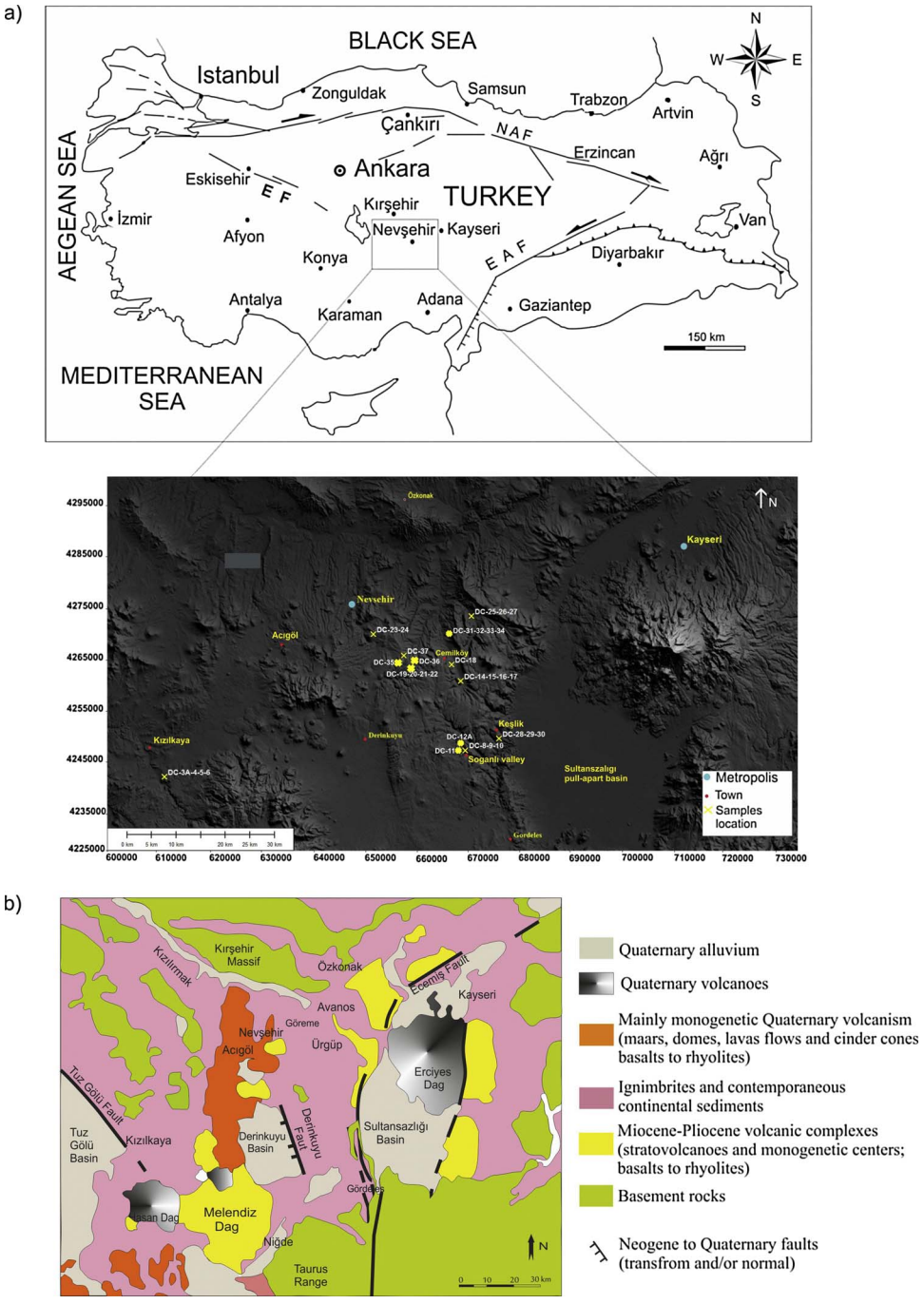

Fig. 1. a) Location of the study area (http://www.jpl.nasa.gov/srtm) b) Geological sketch map of the studied area (modified from Pasquare et al., 1988; Le Pennec et al., 1994; Temel et al., 1998).

geochronology of the CAVP ignimbrites by using zircon (Aydar et al., 2012; Paquette and Le Pennec, 2012), but there is no adequate data for the Cemilköy ignimbrite, a widely exposed and unwelded ignimbrite in the CAVP. Here we present new major, trace element and mineral chemistry data for the Cemilköy ignimbrite. This paper aims to describe the mineralogical-petrological properties of the Cemilköy ignimbrite and shed light on geochemical processes that prevailed during its magmatic evolution.

2. Stratigraphy

Cemilköy ignimbrite is bordered by Özkonak village to the north Sultansazlığı pull-apart basin to the northeast, Selime village to the west, and Soğanlı village to the south (Fig. 1a). The unwelded Cemilköy ignimbrite covers an area of about 8600 km^2, and the estimated bulk volume is 300 km^3 (Le Pennec et al., 1994). Stratigraphic investigations on the Neogene Cappadocian ignimbrites were began with by Pasquare (1968), Pasquare et al. (1988), Innocenti et al. (1975), Temel et al. (1994) and Le Pennec et al. (1994, 2005). The basement rocks consist of Paleozoic-Mesozoic plutonic rocks including ophiolites (Dilek and Sandvol, 2009). The clastic sedimentary deposits and associated volcanic rocks can be divided into three main associations: (1) Yeşilhisar Formation (2) Ürgüp Formation and (3) Quaternary units. In the Ürgüp formation, ignimbrite deposits and lava flows are intercalated with lacustrine sediments (Temel, 1992). The Ürgüp formation comprises eight ignimbrite deposits, two lava flows and one limestone unit (Temel, 1994). The Cemilköy ignimbrite is the most extensive pyroclastic deposit of the Ürgüp formation (Fig. 2). The stratigraphy of the ignimbrite deposits and underlying basement rocks has been inferred by fieldwork and radiometric dating, such as K-Ar, Ar-Ar and $^{206}U/^{238}U$