

## Supplementary Material

### Supplementary Text S1.

#### Geochronologies for all soil carbonate sampling sites (this study)

We refer to Supplementary Table 1 for GPS points and  $\delta^{13}\text{C}$  and  $\delta^{18}\text{O}$  values of the sampled soil carbonates.

##### Holocene site chronologies:

Chronologies of the pre-Holocene Anatolian sampling sites (this study). Holocene soil carbonate horizons were identified based on field relationships and assigned an age of  $5 \pm 5$  ka.

##### Pre-Holocene site chronologies:

For all pre-Holocene soil carbonate samples that were taken from a profile, we averaged ages (see Supplementary Table S1) of the underlying and overlying and isotopically dated volcanics. As such, the age uncertainty spans the entire age range between the underlying and overlying volcanic deposits.

For sections with a single isotopically dated volcanic layer within, below, or above the sampled interval, we extrapolate the average sedimentation rate of 75 m/Myr for the CAP ('unknown' in Supplementary Table S1). The average sedimentation rate is derived from a compilation in Meijers et al. (2018).

Isotopically dated volcanics are available for all pre-Holocene sampled sections, except for site 11AD from the Adana basin (see below).

##### Site/samples: 11AD01-95

##### Basin/area: Adana Basin

##### Locality: Baklalı and Misis

Locality 11AD consists of three sublocalities from time-equivalent deposits in a small area and were therefore merged. A Quaternary age is indicated by the geological map (Ulu, 2002). We assigned a Pleistocene age ( $1.35 \pm 1.25$  Ma) to exclude the Holocene.

##### Site/samples: 14 MM 05-07

##### Basin/area: CAVP

##### Locality: Taşhan

Soil carbonate sampled (N= 3) in between the Çaltepe basalt ( $4.88 \pm 0.04$  Ma,  $^{40}\text{Ar}/^{39}\text{Ar}$ , whole rock; Brocard et al., 2021) and the Valibabatepe ignimbrite ( $2.73 \pm 0.02$  Ma, U-Pb; Friedrichs et al., 2021;  $2.73 \pm 0.08$  Ma,  $^{40}\text{Ar}/^{39}\text{Ar}$ , plagioclase; Higgins et al., 2015). Samples were retrieved from a sequence just below the Valibabatepe ignimbrite, which was emplaced on an already-incising Kızılırmak river valley. Hence, the age of the samples must lie between that of the Çaltepe basalt and the Valibabatepe ignimbrite. Therefore, the estimated age for the samples is  $3.79 \pm 1.09$  Ma.

**Site/samples: 10TG80, 87-91, 93-97**

**Basin/area: Tuz Gölü footwall**

**Locality: Cerit**

Soil carbonates sampled (N= 96) in a sequence above the Kızılkaya ignimbrite ( $5.02 \pm 0.20$  Ma ( $^{40}\text{Ar}/^{39}\text{Ar}$ , sanidine; Özsayın et al., 2013)). The Kızılkaya ignimbrite at this location is underlain by another ignimbrite (age:  $6.81 \pm 0.24$  Ma;  $^{40}\text{Ar}/^{39}\text{Ar}$ , sanidine; Özsayın et al., 2013)). Based on the sedimentation rate between the two ignimbrites (8.0 cm/kyr), the estimated age for the sampled soil carbonates is ca.  $3.86 \pm 0.20$  Ma.

**Site/samples: 12C-070-084**

**Basin/area: CAVP**

**Locality: Güzelöz**

18 m-long interval with soil carbonates, which starts 18 m above the Kızılkaya ignimbrite  $5.02 \pm 0.20$  Ma ( $^{40}\text{Ar}/^{39}\text{Ar}$ , sanidine; Özsayın et al., 2013)). Therefore, the estimated age for the samples is  $4.86 \pm 0.16$  Ma.

**Site/samples: 12C-099-101**

**Basin/area: CAVP**

**Locality: Taskınpaşa Southwest**

Soil carbonates sampled (N= 3) between the Gördeles ( $6.34 \pm 0.07$  Ma; U-Pb, zircon; Aydar et al., 2013) and Kızılkaya ignimbrite ( $5.02 \pm 0.20$  Ma;  $^{40}\text{Ar}/^{39}\text{Ar}$ , sanidine; Özsayın et al., 2013)). Therefore, the estimated age for the samples is  $5.68 \pm 0.66$  Ma.

**Site/samples: 10CKK**

**Basin/area: CAVP**

**Locality: Şahinefendi**

Soil carbonates sampled (N= 86) between the Gördeles ( $6.34 \pm 0.07$  Ma; U-Pb, zircon; Aydar et al., 2013) and Kızılkaya ignimbrite ( $5.02 \pm 0.20$  Ma;  $^{40}\text{Ar}/^{39}\text{Ar}$ , sanidine; Özsayın et al., 2013)). Therefore, the estimated age for the samples is  $5.68 \pm 0.66$  Ma.

**Site/samples: 12C-002-023**

**Basin/area: CAVP**

**Locality: Orta Tepe West**

Soil carbonates were sampled (N= 22) between the Tahar and Gördeles ignimbrites. The ages of the Tahar and Gördeles ignimbrites are reversed, hence the time interval of soil carbonate formation was set at the widest possible interval, i.e. between  $6.34 \pm 0.07$  Ma ( $^{40}\text{Ar}/^{39}\text{Ar}$ , plagioclase; Aydar et al., 2012) and  $6.07 \pm 0.67$  Ma (U-Pb, zircon; Aydar et al., 2012). The estimated age for the samples is  $6.21 \pm 0.14$  Ma.

**Site/samples: 12C-063-069**

**Basin/area: CAVP**

**Locality: Taskınpaşa South**

Soil carbonates within pebbly mudstones were sampled (N= 6) between the Tahar and Gördeles ignimbrites. The ages of the Tahar and Gördeles ignimbrites are reversed, hence the time interval of soil carbonate formation was set at the widest possible interval, i.e. between  $6.34 \pm 0.07$  Ma ( $^{40}\text{Ar}/^{39}\text{Ar}$ , plagioclase; Aydar et al., 2012) and  $6.07 \pm 0.67$  Ma (U-Pb, zircon; Aydar et al., 2012). The estimated age for the samples is  $6.21 \pm 0.14$  Ma.

**Site/samples: 12C-025-046**

**Basin/area: CAVP**

**Locality: Orta Tepe South**

Soil carbonates formed within conglomerates and sandstones were sampled (N= 22) between the Cemilköy ignimbrite and younger airfall deposits. Cemilköy ignimbrite:  $7.20 \pm 0.09$  Ma ( $^{40}\text{Ar}/^{39}\text{Ar}$ , plagioclase; Aydar et al., 2012), airfall deposits: ca. 6.9 Ma (U-Pb, zircon; Aydar et al., 2012). The estimated age for the samples is  $7.05 \pm 0.15$  Ma.

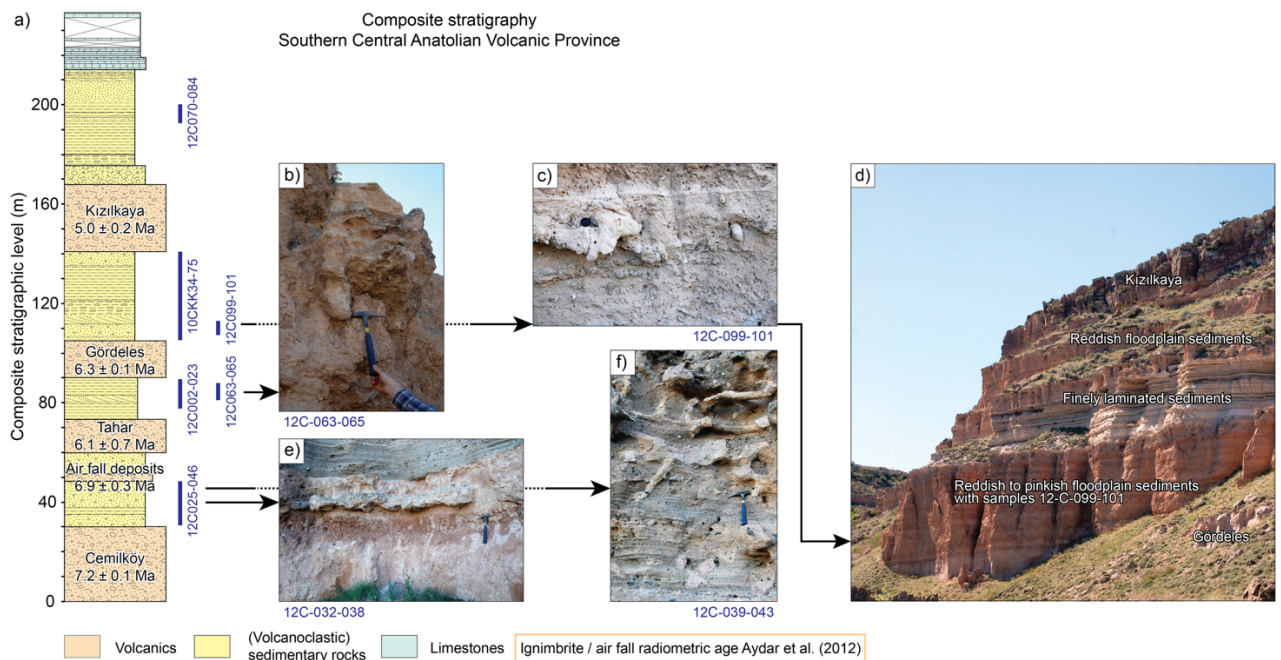
**Site/samples: 12C-047-062**

**Basin/area: CAVP**

**Locality: Mustafapaşa**

Red clay floodplain deposits with white soil carbonate nodules sampled (N= 24) just below the Damsa lavas. The Damsa lavas are likely only slightly older than the Kavak ignimbrite, which is dated at  $9.12 \pm 0.09$  Ma ( $^{40}\text{Ar}/^{39}\text{Ar}$ , plagioclase; Aydar et al., 2012) and  $9.13 \pm 0.51$  Ma (U-Pb, zircon; Aydar et al., 2012). The soils are most likely preserved because of the overlying Damsa lavas; volcanism therefore likely immediately postdated the time period of soil formation. The estimated age for the samples is  $9.88 \pm 0.75$  Ma.

## Supplementary Figure S1



- a) Composite stratigraphy of the southern Central Anatolian Volcanic Province (near the villages of Şahinefendi, Taşkinpaşa, and Güzelöz) showing the six sampled intervals (12C025-046, 12C002-

023, 12C063-065, 12C099-101, 10CKK, and 12C070-084) which were sampled for soil carbonates.

- b) Interval with soil carbonate nodules from which section 12C063-65 was sampled.
- c) Sub-interval with carbonate rhizoliths from which section 12C099-101 was sampled.
- d) Field view of the interval between the Gördeles and Kızılkaya ignimbrites, showing reddish to pinkish floodplain sediments from which section 12C099-101 was sampled (see c) for close up).
- e) Interval containing calcretes and rhizoliths from which carbonate samples 12C032-038 from section 12C025-046 were collected.
- f) Interval with carbonate rhizoliths from which samples 12C039-043 from section 12C025-046 were collected.

## References

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