Developing a multi-methods dating framework for Eastern Mediterranean region over the Late Quaternary

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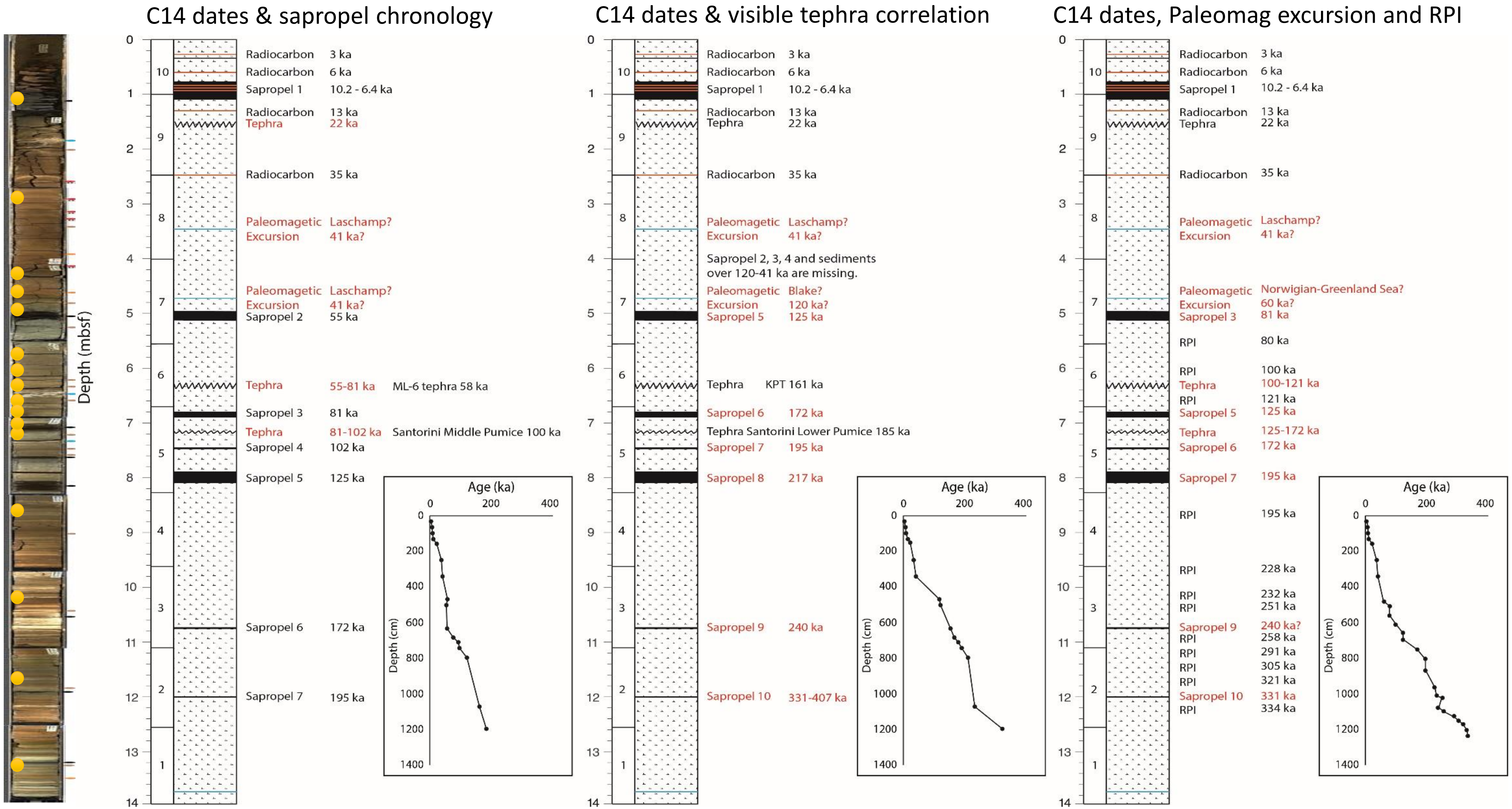

OSL samples Figure 1. Age models for core LC31, depending on dating assumptions. Black text denotes assumptions, red text denotes inferred ages.

Problems

Different chronological controls

↓

Completely different age models

↓

Core length captures 200ka or 350ka??

Aim: To pin down a more precise chronology for palaeoenvironmental reconstruction

Preliminary dating work has been done.

Sapropel chronology

- organic-rich dark-coloured sediments mainly formed in anoxic bottom waters.
- used as **event horizons** chronology.

Radiocarbon

- Abu-Zied et al. (2008) reported radiocarbon dates in the top two sections of core LC31.
- More radiocarbon dates will help to **pin down paleomag excursion events**, **calibrate OSL dates** and **estimate ages of some tephra layers**.

Paleomagnetism

- Inclination indicates paleomagnetic **excursion** signals
- Tuning **Relative Paleointensity (RPI)** to Global paleointensity records PISO 1500 (Channell *et al.*, 2009) and SINT 800 (Guyodo & Valet, 1999)

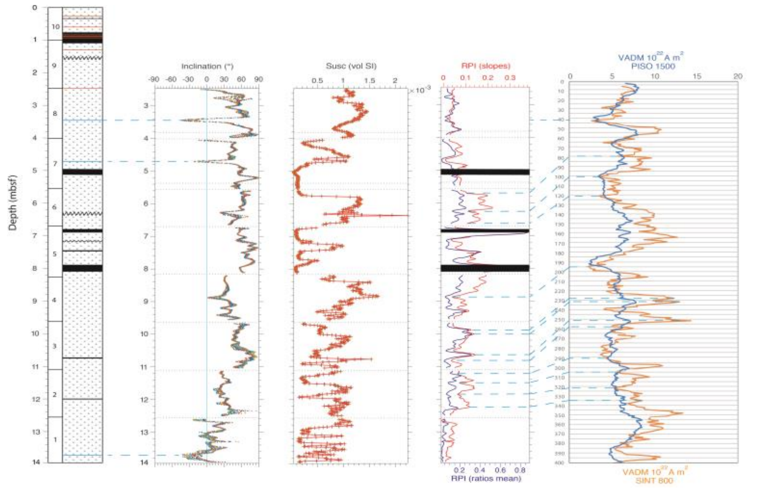

Figure 2. Magnetic profiles of core LC31 and comparison to global paleointensity records.

Background

The Eastern Mediterranean is an important region for understanding the late Quaternary, as there is evidence for a complex pattern of climatic and environmental change, influenced by orbital forcing and complex feedback mechanisms (Rohling *et al.*, 2013). It is also a key region for examining the dispersal of humans out of Africa.

Core MD81-LC31

- 14 m marine core

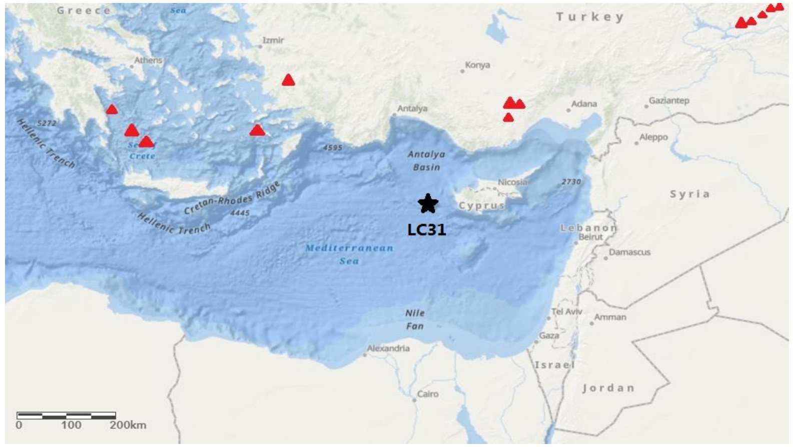

Figure 3. Map of Core LC31 location and volcanoes.

↑ E. Med is surrounded by many active volcanoes (**Aegean**, **Anatolian** and potential **Italian**) during Quaternary, previous studies have reported the existence of multiple tephra layers in the marine core (Keller *et al.*, 1978; Wulf *et al.*, 2018; RESET database).

Ongoing dating work…

Tephrochronology

E. Med is a place with huge potential to apply crypto-tephrochronology. Thus we aim to build a complete continuous tephrostratigraphy by using core LC31 to resolve:

- **Relatively limited geochemical database from different volcanic centres for the region**
- **Lack of long cryptotephra stratigraphic records**

OSL dating

16 samples have been taken for OSL dating across all sections and some are above/below sapropels and visible tephras (see slide 1 log).

The application of novel luminescence methods to deep-sea cores has the potential to allow direct dating of these sediments to >200 ka, considerably **beyond the range of radiocarbon dating**.

With the aid of tephra and OSL dates, we aim to deliver

- ➢ **An integrated multi-methods chronology for the E. Med over the last ~200,000 years**
- ➢ **The first marine crypto-tephra record in Antalyan basin**

Ongoing work

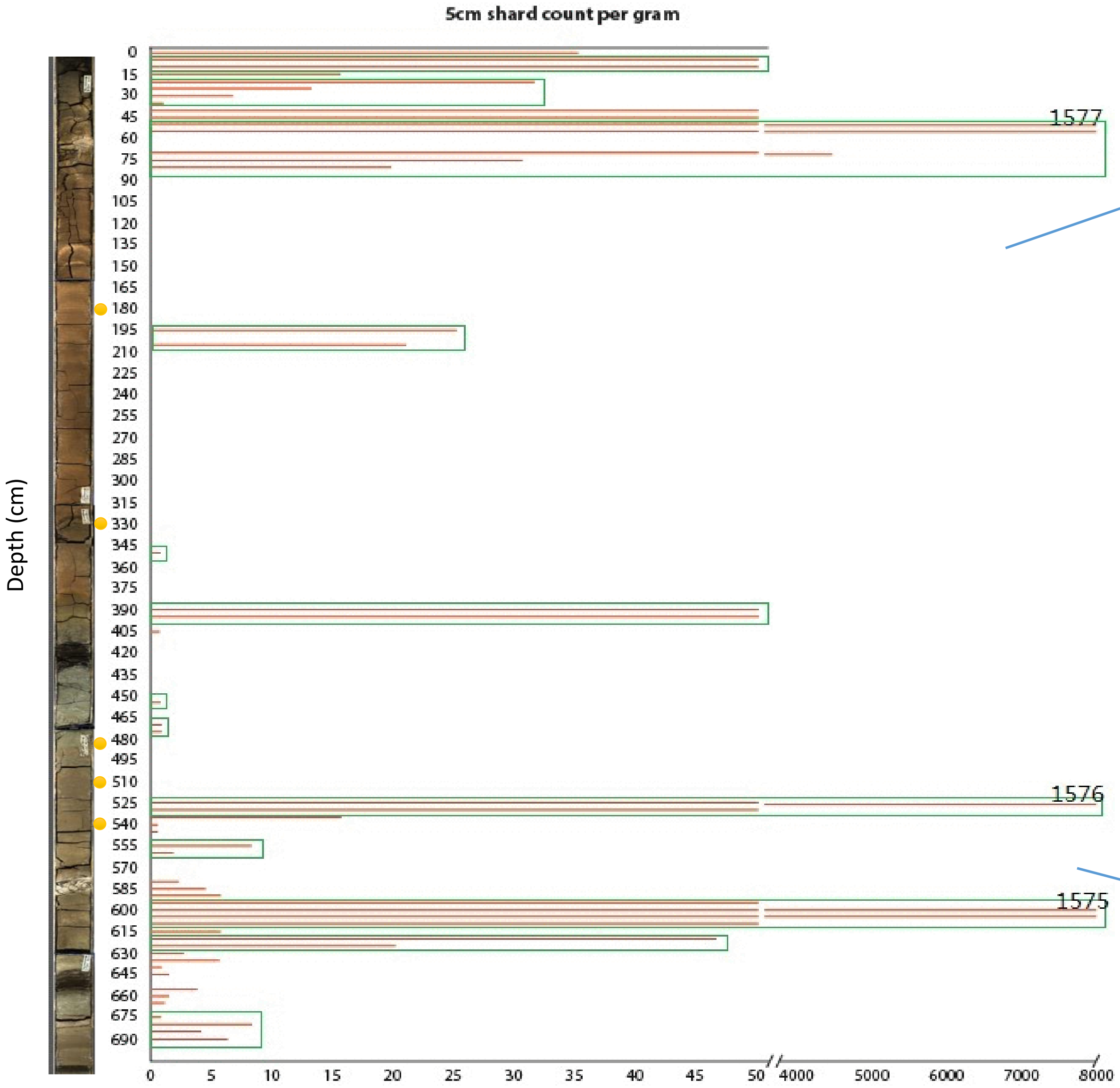

Figure 4. The tephrostratigraphy of core LC31 at 5 cm resolution.

Three visible tephra layers geochemistry

Tephra	Potential correlation	Age	Provenance
1577	Cape Riva	22 ka	Santorini
1576	ML-6 tephra? Kos Plateau Tuff?	58 ± 5.69 ka? 161 ka?	Yali/Kos/Nisyros or Turkey
1575	Santorini Middle Pumice? Santorini Lower Pumice?	100 ka? 185 ka?	Santorini

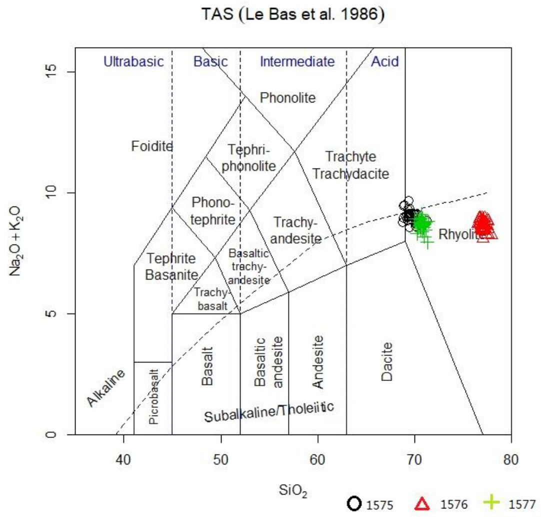

Figure 5. Major element on TAS classification diagram (Le Bas *et al*., 1986)

Volcanic provenance

Some recent studies have reported detailed **Santorini** crypto-tephrostratigraphy in marine records (Satow *et al*., 2015) and geochemistry of proximal deposits (Wulf *et al*., 2020). This work has huge potential to build up the tephrostratigraphy to understudied **Kos/Yali/Nisyros** and **Turkish** volcanoes.

Multiple tephra peaks

It is not sure if all tephra peaks are primary fall or reworked visible tephra, higher resolution point samples and geochemical analysis are required.

Overall, tracking **cryptotephra** in marine sediments along with multiple dating techniques will provide a precise age and dating framework to synchronise for archaeological and palaeoenvironmental archives.

References: **1** Blockley et al, *Leverhuhulme* RPG-2017-087; **2** Armitage et al., 2015. *Quat. Geo.*, *30*, pp.270-274; **3** Armitage, & Pinder, 2017. *Quat. Geo.*, *39*, pp.124-130; **4** Bourne, et al., 2010. *Quat. Sci. Rev.*, *29*, pp. 3079-3094; **5** Channell, J.E.T., et al., 2009. *EPSL* 283, pp.14-23; **6** Federman, & Carey, S.N., 1980. *Quat. Res*, *13*, pp.160-171; **7** Guyodo, & Valet, 1999. *Nature*, *399*, p.249; **8** Margari, et al., 2007.*JVGR*, *163*, pp.34-54. **9** Nowaczyk, et al., 2013. *EPSL*, *384*, pp.1-16; **10** Nowaczyk, et al., 1994. *Geo. J. Int.*, *117*, pp.453-471; **11** Rohling, et al. 2013. *Current Anth.*, *54*, S183-S201; **12** Satow, C., et al. 2015. *Quat. Sci. Rev.*, *117*, 96-112; **13** Satow, C., et al. 2020. *Quaternary*., 3, pp.6; **14** Smith, et al., 1996. *Geo. Res. Let*, *23*, pp.3047-3050; **15** Wulf et al., 2018. *Quat Sci Rev*, *186*, pp.236-262; **16** Wulf, S., et al., 2020. *Earth Sci Rev*, pp.102964.