ABSOLUTE ANSWERS IN ARCHAEOLOGY: LUMINESCENCE DATING OF ARCHAEOLOGICAL MATERIALS AND SITES

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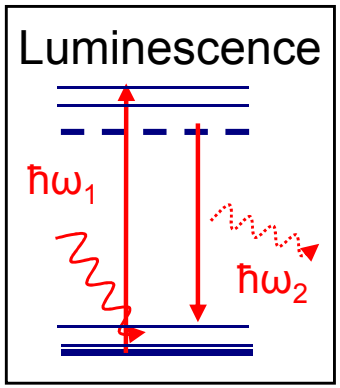
luminescence dating issues....

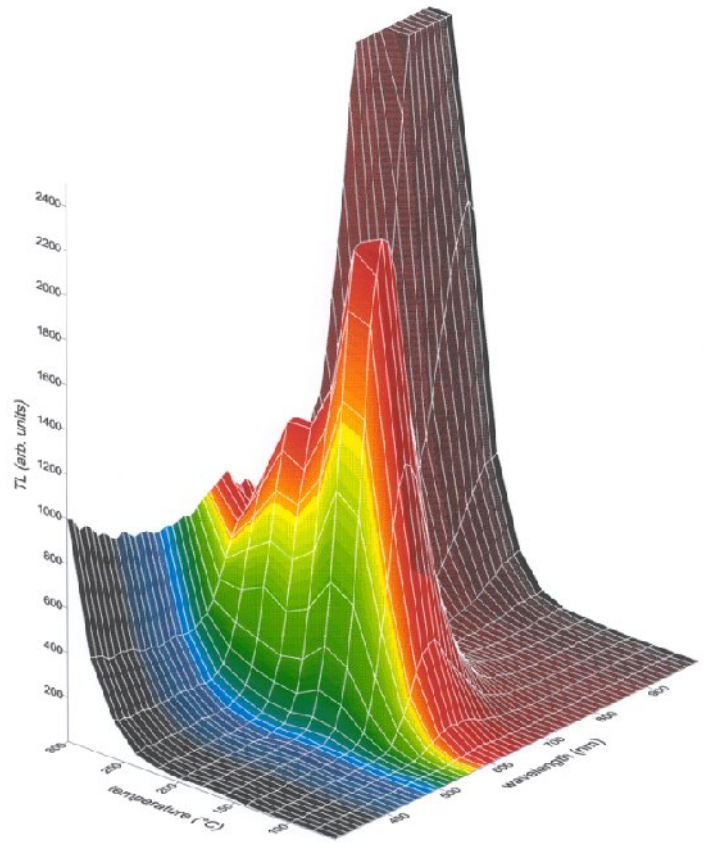
AGE $t = \frac{D}{\dot{D}} = \frac{I}{S \cdot \dot{D}}$

I **intensity of luminescence**
S **sensitivity,**

D dose-rate (cosmic, uranium, thorium, potassium)

.....

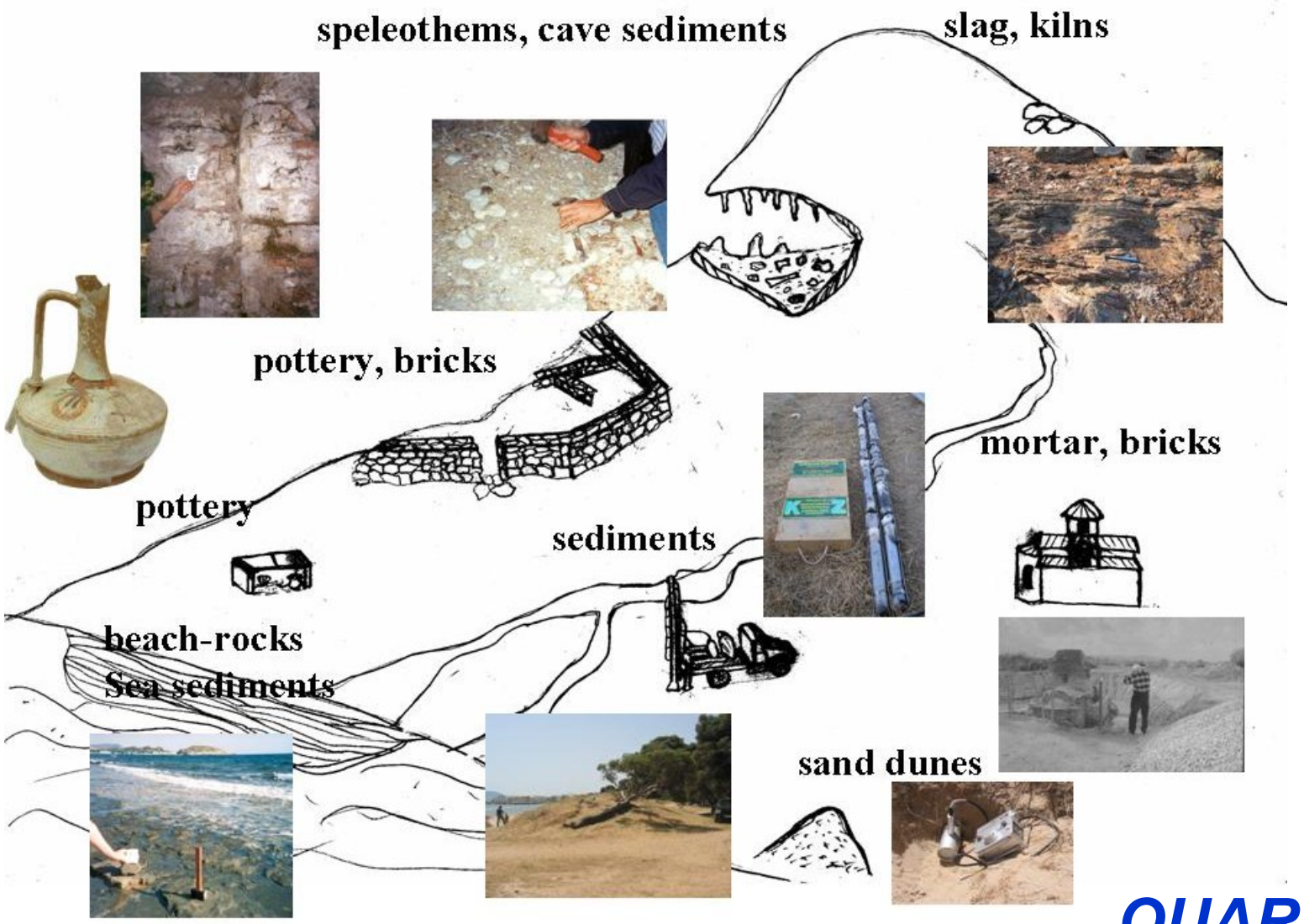




(more than a dosen of parameters...

5% accuracy)

range of materials/applicability



QUARTZ!!!!

two main aims of variation

- **Intra (Accuracy)**
- sensitivity/dose response
- internal/external dosimetry
- material characterisation

- **Inter (Precision)**

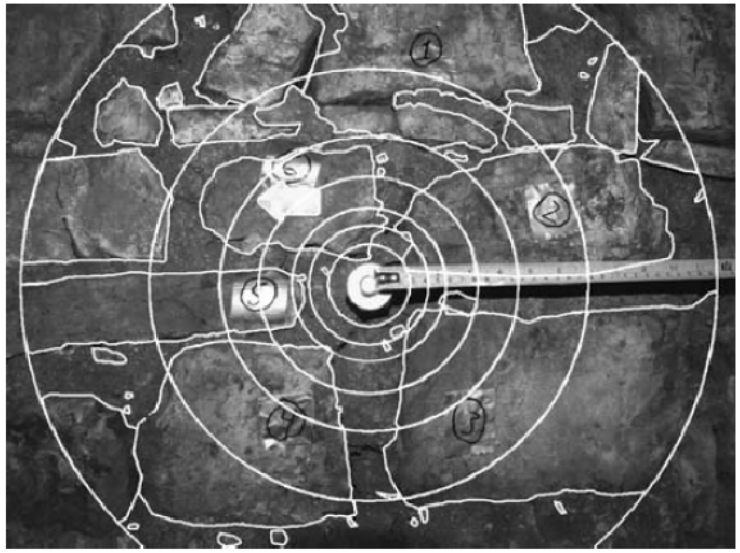
spatial distribution

material complexity

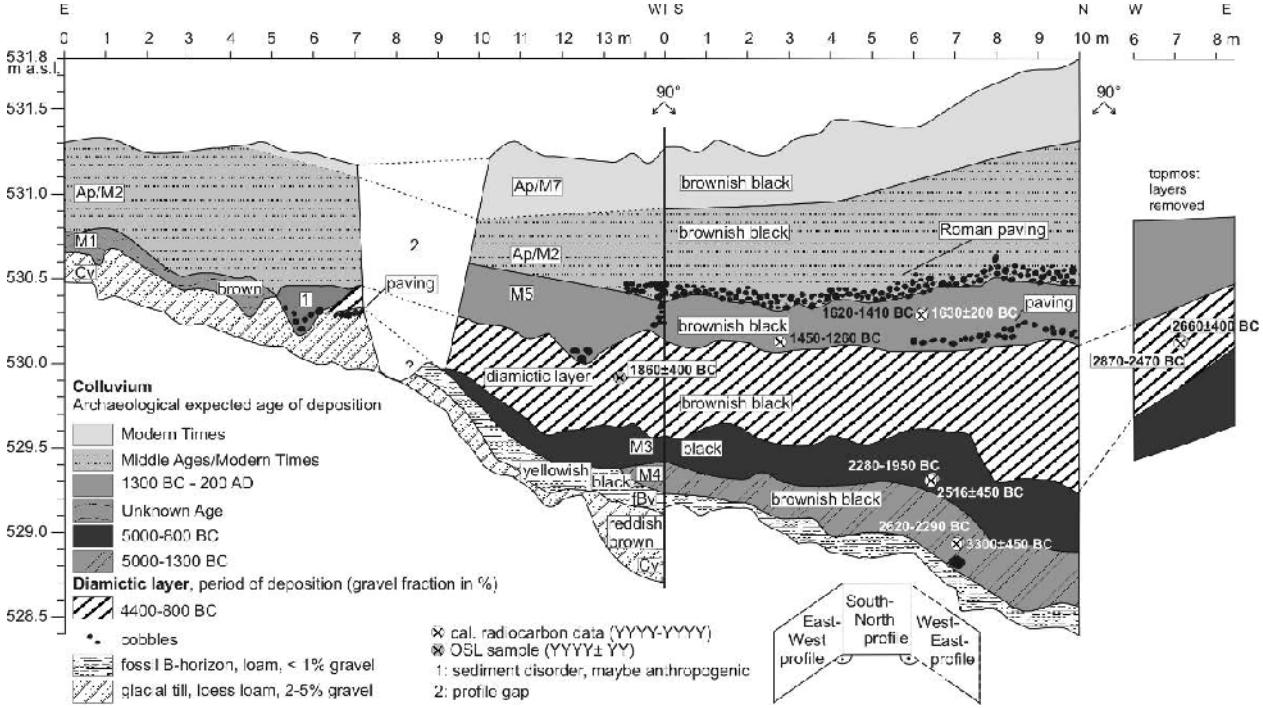
seasonal variation

bio/geo-destruction

heterogeneity / complexity



Feathers, 20004



Liritzis et al., 2010

heterogeneity / spatial variation

$$\dot{D}_\gamma = p\dot{D}_\gamma^{\text{mortar}} + q\dot{D}_\gamma^{\text{brick}} + (1 - p - q)\,\dot{D}_\gamma^{\text{limestone}}$$

Zacharias et., 2002

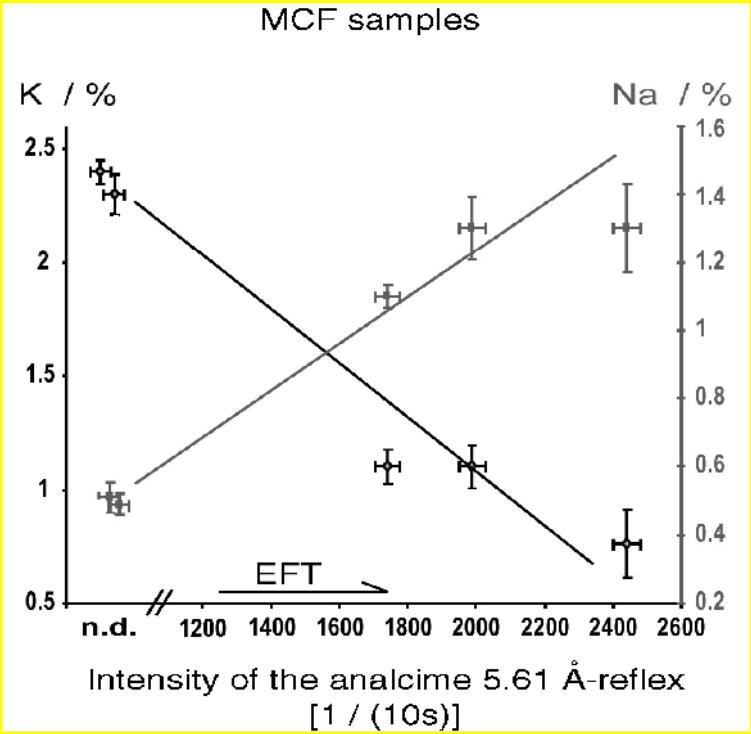
Zacharias et. al., 2012

seasonal variation/ heterogeinety (bio,geo) turbation

MANI PELOPONNESE

ANTHEDONA, BEOTEA

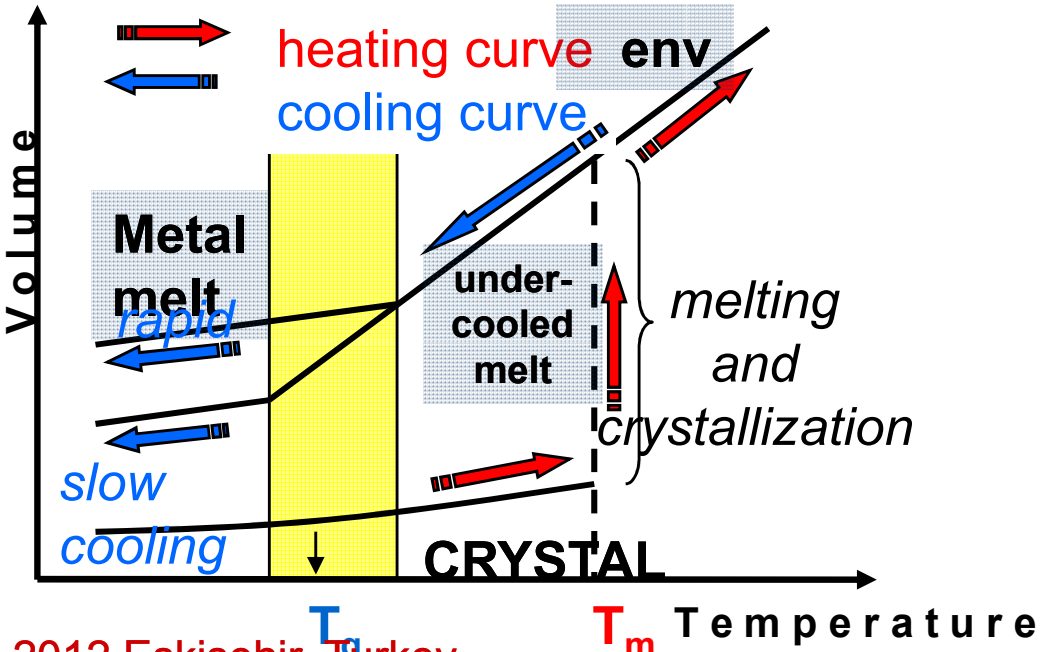
alterations (verified – so far- only for K leaching)

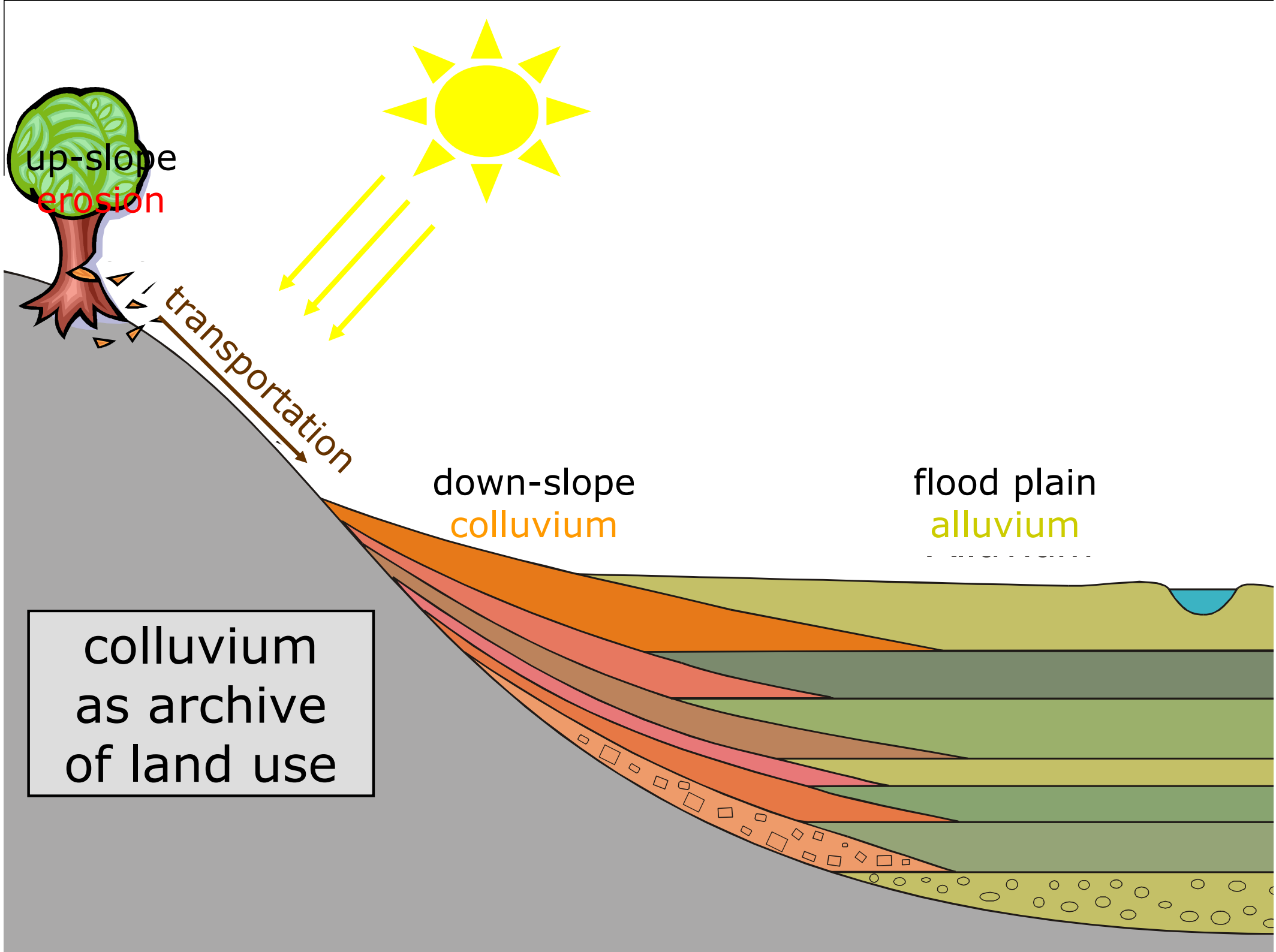


(Schwedt and Zacharias, 2004)

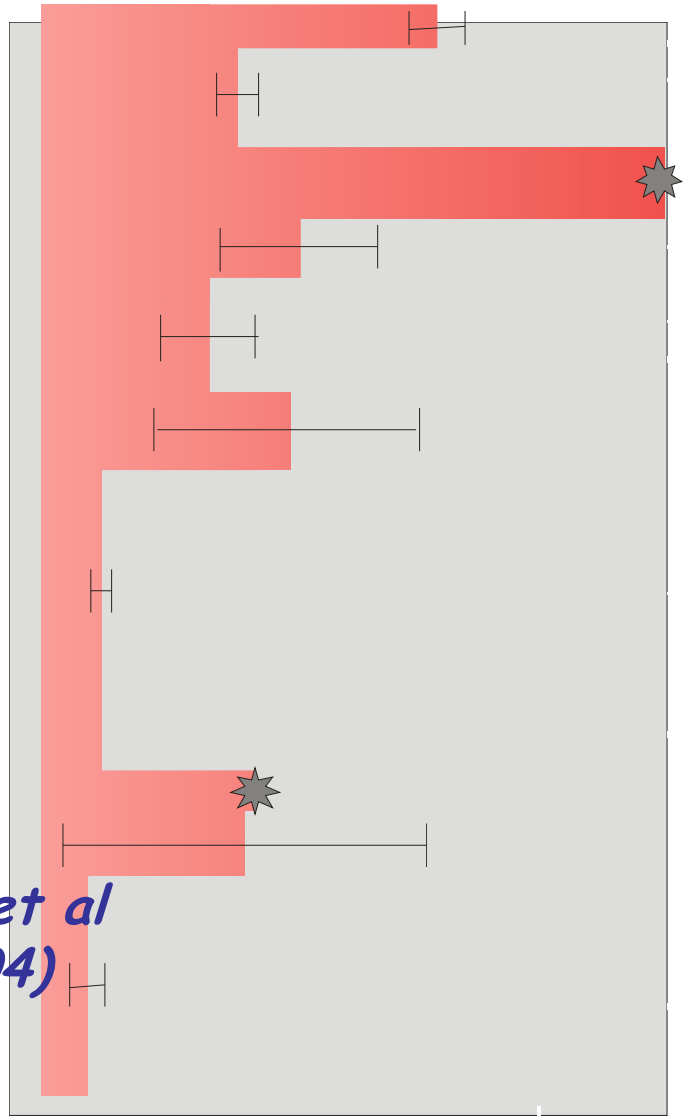
(Zacharias et al., 2006a, 2006b, 2010)

Pottery, bricks, metallurgical ceramics




up-slope
erosion
transportation
down-slope
colluvium
flood plain
alluvium
colluvium
as archive
of land use

Phlious: Sedimentation rates (*B2*)



years [ka]

Modern
Ottoman
Medieval
Roman
Classic
Early Iron Age
Bronze Age
Chalkolithic
Neolithic
Pre-Neolithic

cultural period

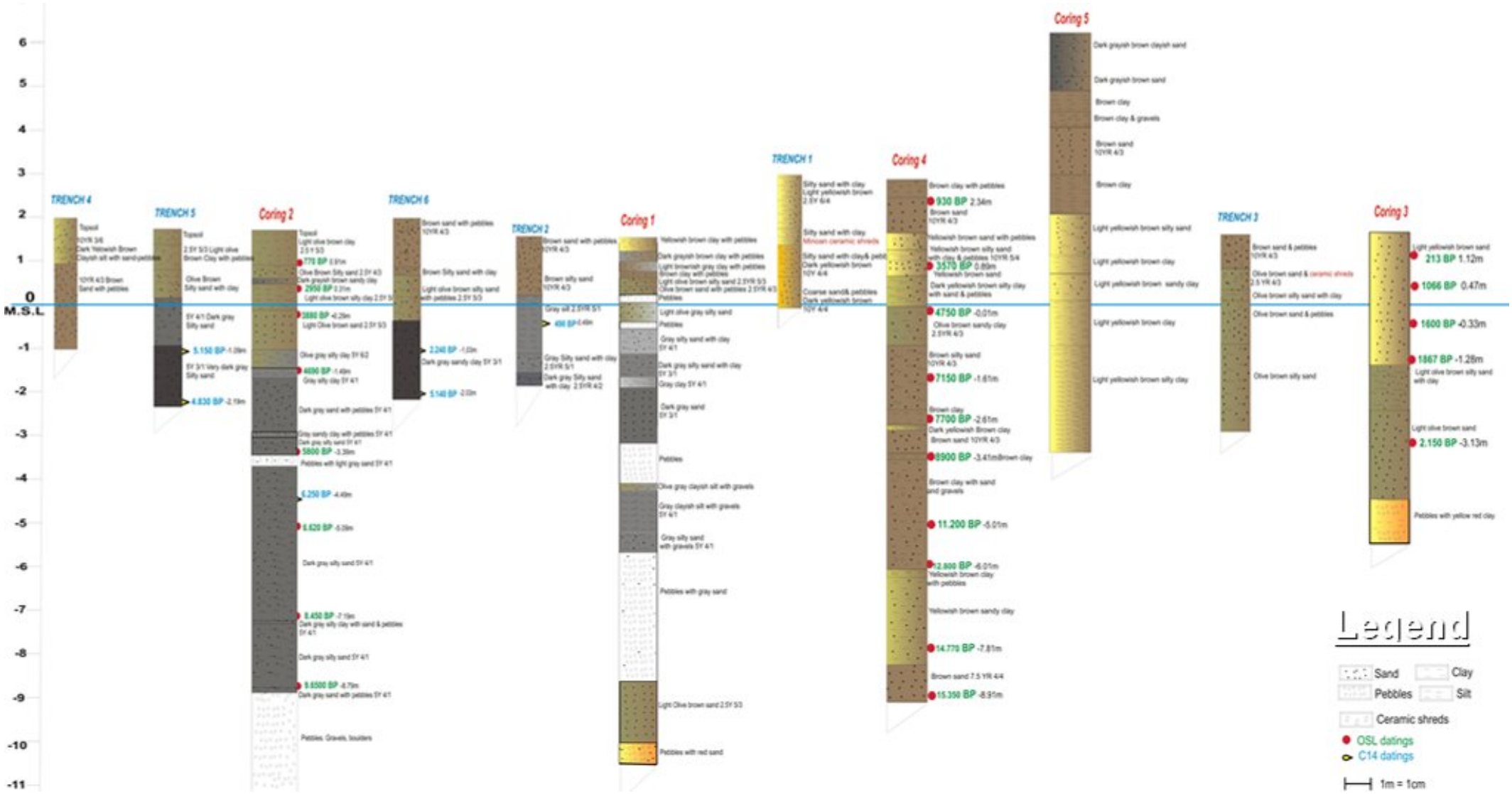
(Fuchs et al, Wagner, et al 2001a,b, 2003, 2004)

sedimentation rate [mm/a]

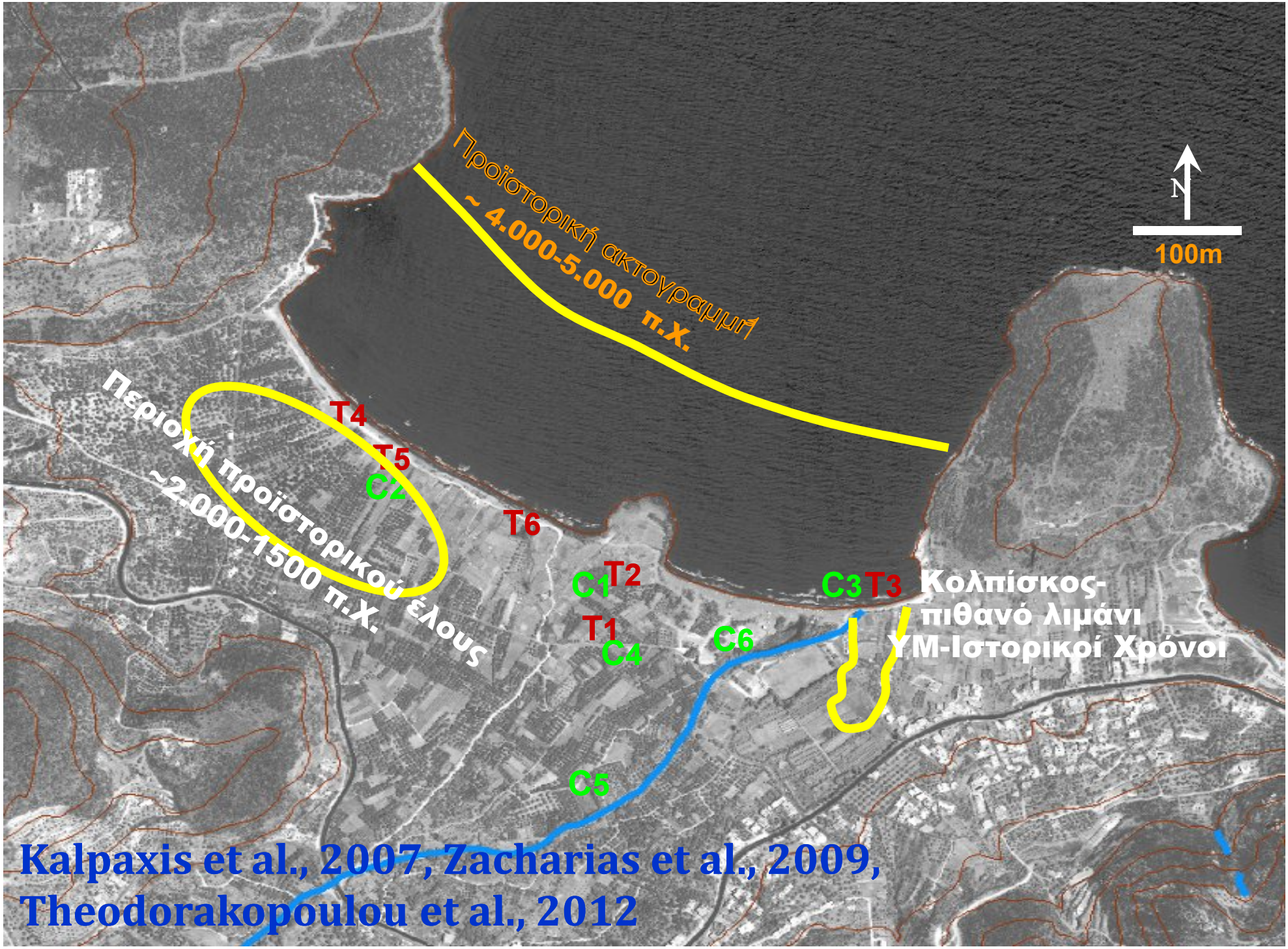
NE Crete – Istron (2005-2009)

(C-coring T- trenches)

Sedimentological units (columns) types of sediments, DATES (OSL, 14C)

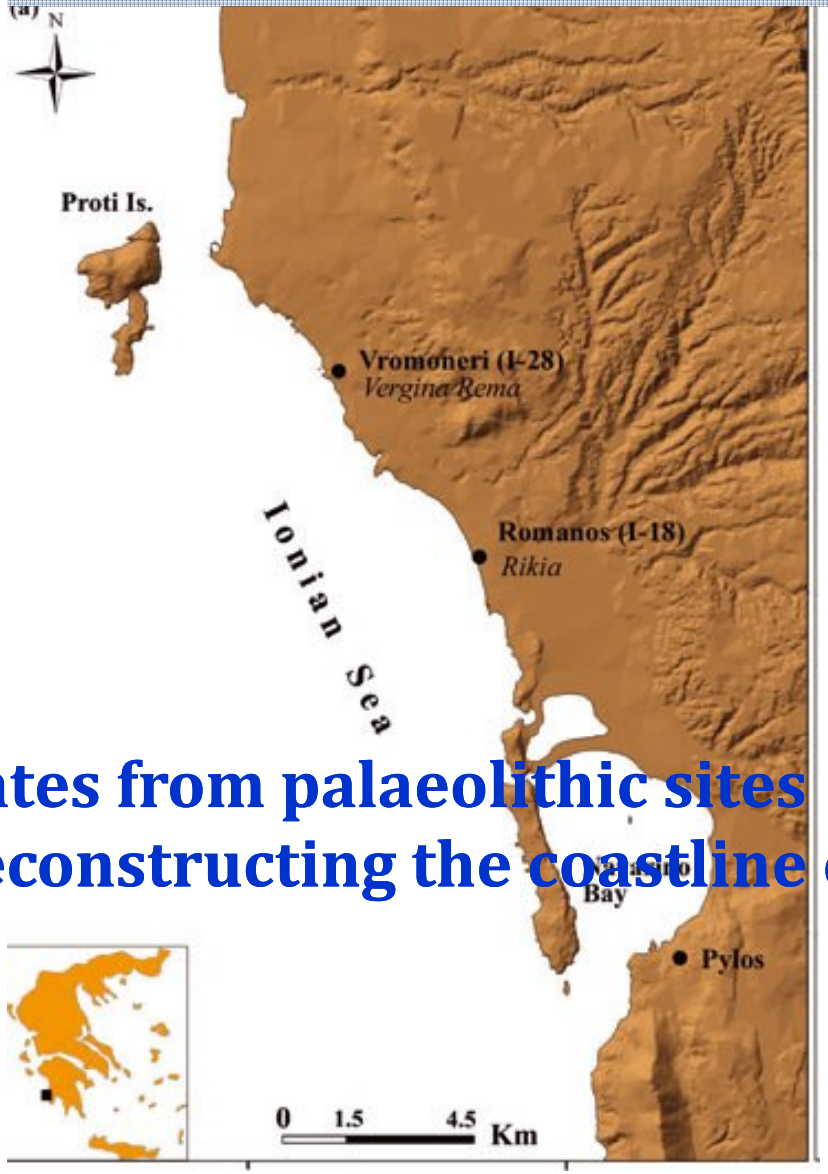


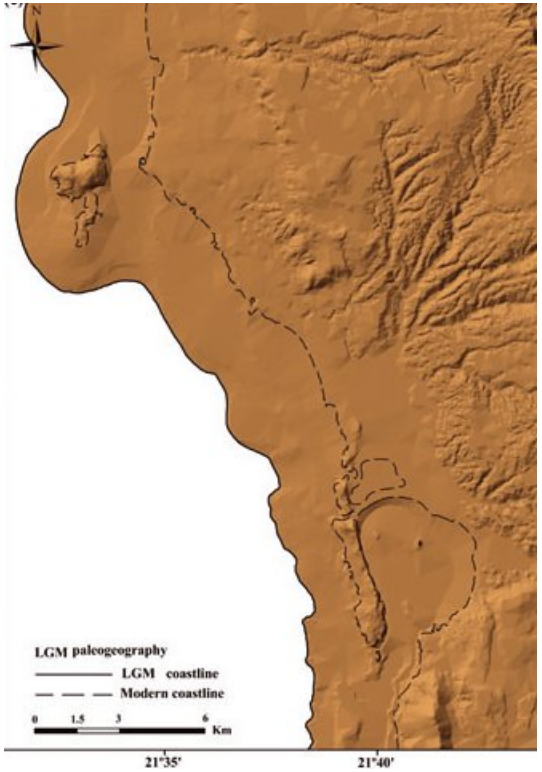
reconstructing the holocene landscape



Kalpaxis et al., 2007, Zacharias et al., 2009, Theodorakopoulou et al., 2012

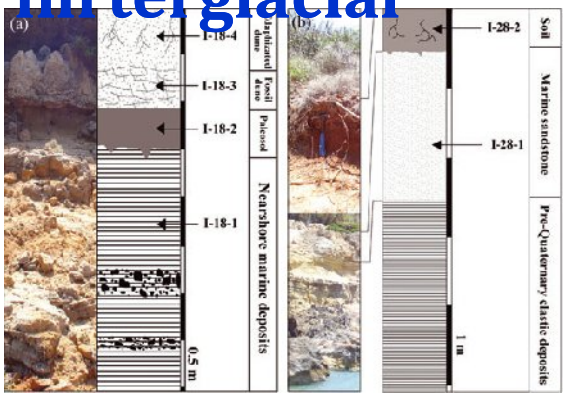
SW Peloponnese (2006 - 2010)





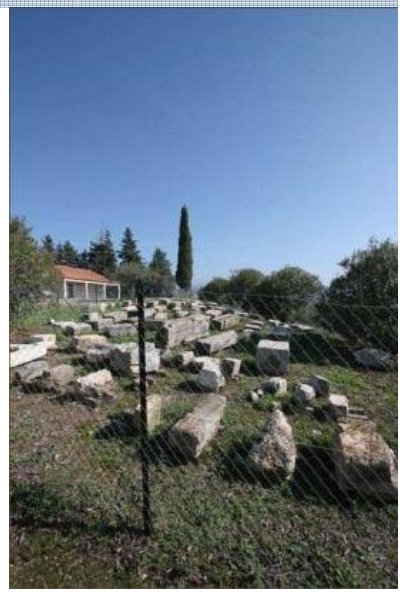
Dates from palaeolithic sites

Reconstructing the coastline of the last inrterglacial

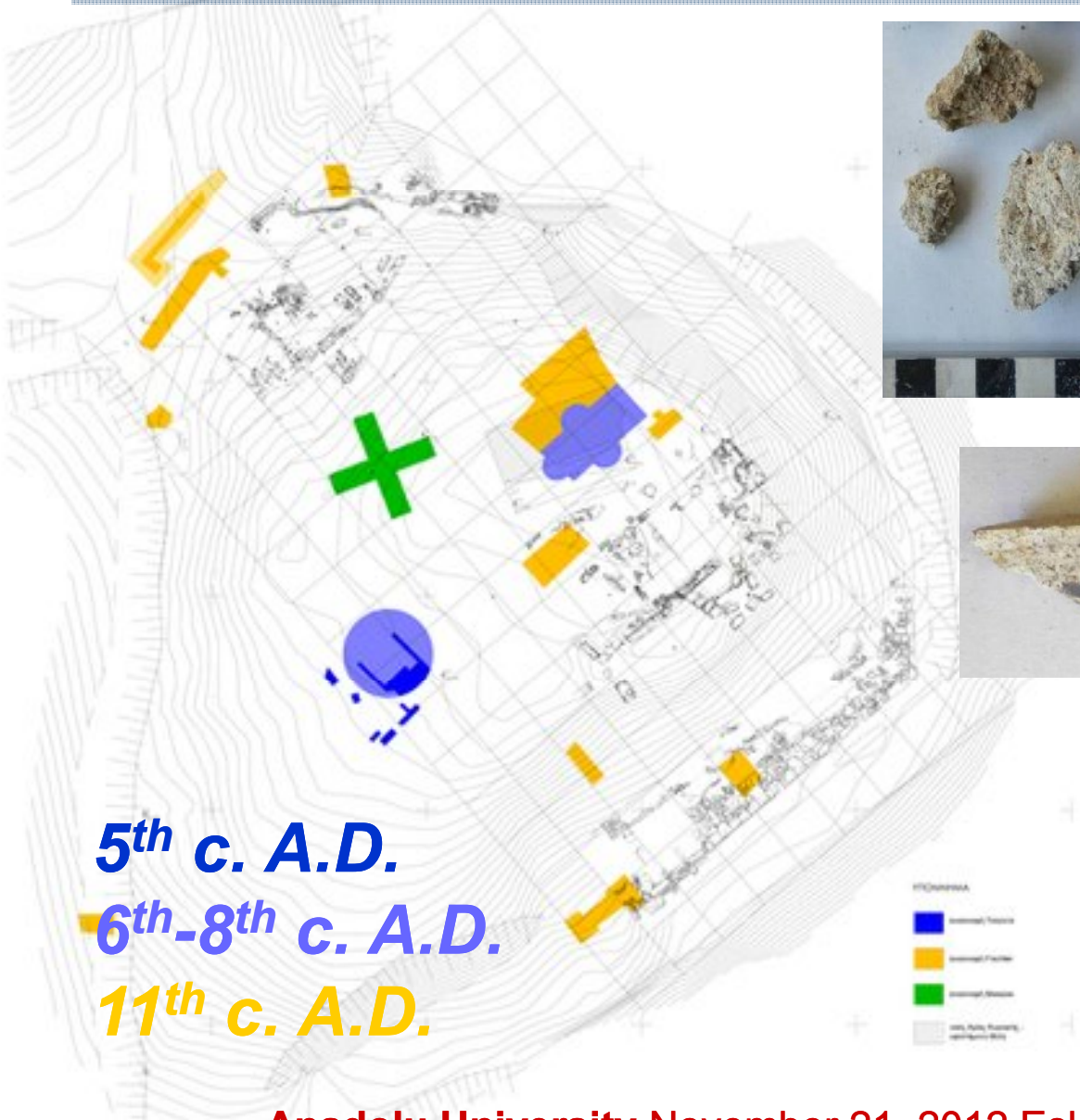


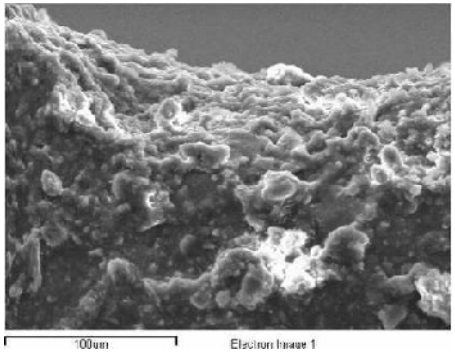
Athanassas and Zacharias, 2010

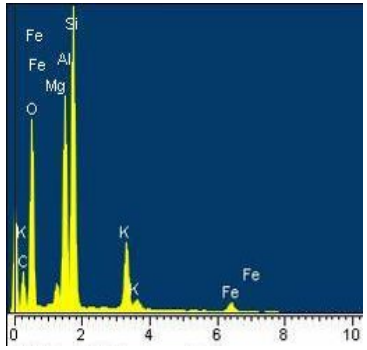
Apollo Temple, Amikles, Laconia (2012)

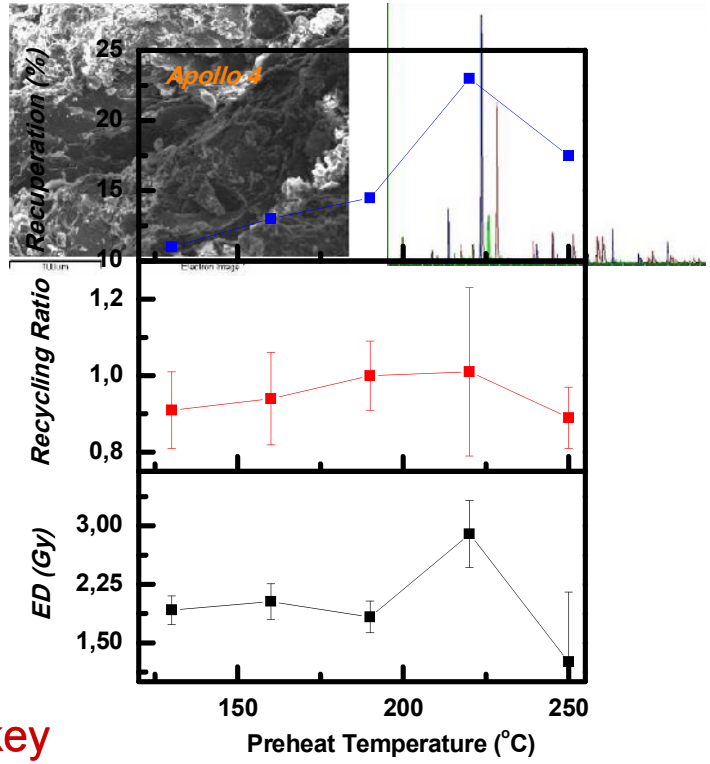


mortar OSL dating and characterisation









5th c. A.D.

6th-8th c. A.D.

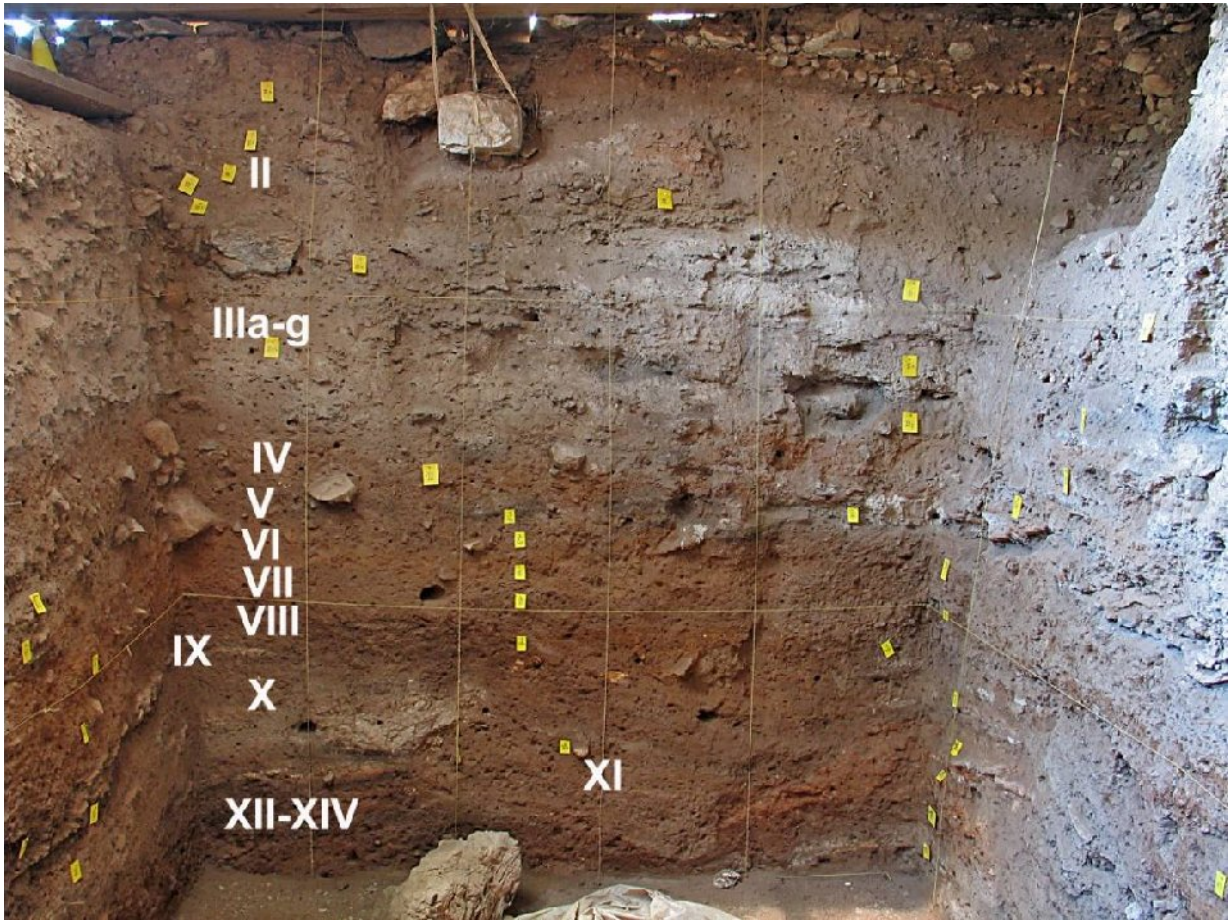
11th c. A.D.

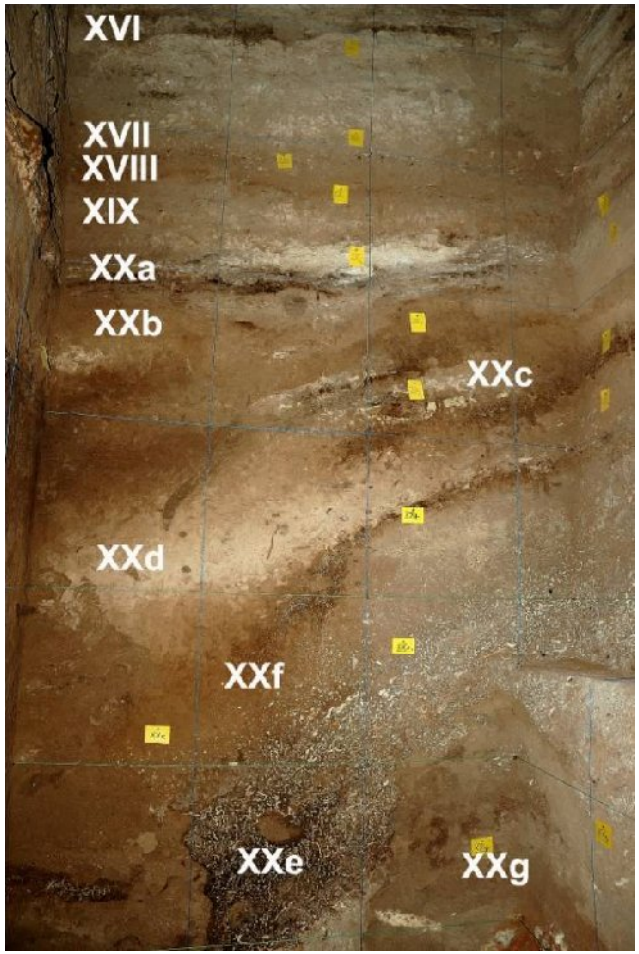
Klissoura, Argolid (2011-2012)

Klissoura Cave 1 preserves a long series of Middle Paleolithic, Upper Paleolithic and Mesolithic cultural layers, interrupted by at least three significant erosional hiatuses. ..
The sedimentary features, artifacts and animal remains of the Upper Paleolithic though Mesolithic layers testify a wide range of on-site activities, with complex cycles of feature construction and abandonment…
The industry of Layer V closely resembles Uluzzian assemblages from southern Italy. Its age remains uncertain but almost certainly exceeds 39 kyrs BP.. (Stiner et al., 2010).

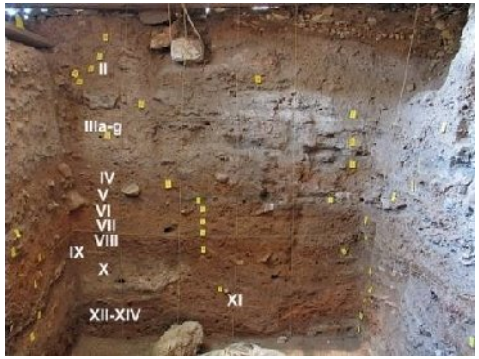
… reports on 29 radiocarbon dates from Middle and Upper Paleolithic layers .. all but two of the dates were obtained from material identified as wood charcoal. The radiocarbon dates from the Aurignacian of layers IIIe–g and IV show general stratigraphic consistency, and fit with published ages from other Aurignacian assemblages in the Balkans. Age esti mates for layer V, associated with the early Upper Paleolithic Uluzzian assemblage, are ambiguous.... (Kuhn et al., 2010)

Klissoura, Argolid (2011-2012)

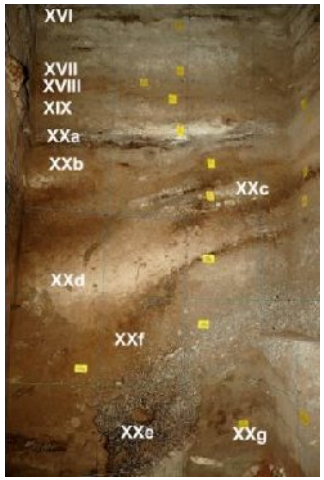




LUMINESCENCE DATA 2011-2012)



Layer (square)	*Depth (cm)*	*OSL ED (error) [Gy]*	*DR (error) [mGy/yr]*	*Re-OSL ED (error) [Gy]*	*OSL age (1σ) [ka]*	*Re-OSL age (1σ) [ka]*
VII (B3)	195	77.5 (5.1)	1.73 (0.12)	-	**44.80 (3.80)**	-
VIII (B3)	215	74.30 (5.85)	1.61 (0.12)	-	**46.15 (4.15)**	-
XI (AA3)	250	40.20 (5.65)	0.98 (0.08)	-	**41.02 (3.90)**	-
XII (AA3)	270	93.30 (8.15)	1.73 (0.12)	-	**53.93 (4.97)**	-
XIV (AA3)	290	166.15 (11.36)	2.23 (0.16)	178.56 (15.3)	**74.51 (5.93)**	**80.07 (6.13)**
XV-XIa (AA3)	320	163.80 (10.15)	2.15 (0.17)	-	**76.18 (6.15)**	-
XVI (A2)	360	190.55 (12.50)	2.31 (0.17)	-	**82.49 (6.66)**	-
XVII (A2)	390	195.98 (15.15)	2.15 (0.17)	-	**91.15 (6.89)**	-
XVIII (A2)	420	196.83 (17.20)	2.12 (0.17)	-	**92.84 (7.75)**	-
XXa (A1)	440	117.22 (4.55)	1.69 (0.14)	128.78 (8.23)	**69.36 (6.90)**	**76.20 (5.35)**
XXc (A1)	485	136.80 (5.80)	1.71 (0.13)	-	**80.00 (7.45)**	-
XXf (A1)	520	148.05 (6.55)	1.72 (0.14)	156.65 (9.36)	**86.08 (6.75)**	**91.08 (7.85)**
XXe (A1)	590	179.25 (6.78)	1.75 (0.15)	183.35 (12.3)	**102.43 (8.30)**	**104.77 (8.75)**
XXg (A1)	630	276.22 (9.92)	2.03 (0.18)	261.35 (15.9)	**136.07 (10.5)**	**128.74 (9.00)**
XIX (BB1)	620**	123.20 (4.95)	1.63 (0.11)	133.50 (9.55)	**75.58 (6.35)**	**81.90 (6.75)**



Summarizing

- interdisciplinary approaches
- combined methodologies
- CONTEXT
- awareness about alterations/contamination/deviations…
- phosphate salts caused disturbances on dosimetry of cave sediments
- Dates from a few thousand up to 2 hundred thousands (200 – 200.000 years) and more …

Thank YOU

Also my Colleagues

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A. Oikonomou,