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SURFACE LUMINESCENCE DATING OF 'DRAGON HOUSES' AND ARMENA GATE AT STYRA (EUBOEA, GREECE)

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ABSTRACT

The Optical Stimulated Luminescence (OSL) surface dating employing the single-aliquot regenerative (SAR) technique on quartz was applied to some small enigmatic buildings made of large marble schist slabs in a skillful corbelling technique, and a fortified megalithic gate, at Styra, Kapsala, Laka Palli and Kastro Armena in southern Euboea. The function and origins of the structures have created a puzzle that has fed the imagination and lead to various interpretations by many scholars. No archaeological excavations or methods of dating have been available for the megalithic-like structures. The dates reported suggest the earliest construction to have taken place during the Classical period. Re-use of these structures has occurred during Hellenistic and Roman times (the latter associated with the large scale quarrying of marbles), as well as, in Medieval times (found in agreement with the historical literature) and the contemporary period (as reported by shepherds). In all cases the datable slabs were rather reset as repairs.

KEYWORDS: OSL, Luminescence, Dragon Houses, Styra, Armena, Dating, Kapsala, Laka Palli, Euboea

INTRODUCTION

The Dragon houses are approximately two dozen mysterious structures in the area of Styra in southern Euboea (others include one on Mount Hymettos in Attica and several in Asia Minor near the Halicarnassus peninsula) that have lead to various opinions regarding construction date and function (Fig. 1).

The Dragon houses at Styra have variable dimensions of about 3.50 - 6.00 width x 13.0 - 9.00 m length, and wall thickness of ~2.00-2.50 m.

The thickness of the megalithic slabs varies in size: 1.70x 0.84 m, 2.10x 0.60 m, 2.00x0.65 m, and the slabs in the trilithon (pi like dolmen) are 2.30x1.60x0.25 m, weighing around 10 tons.

A detailed architectural study regarding stones *in situ* on the edges of the roofs as "counterweights" and the corbelling in general and comparisons of these megalithic buildings has been made by Moutsopoulos (1960, 1982) and Carpenter and Boyd (1977).

Fig. 1 Satellite view of Styra area indicating the sites

Hawkins (1820) was the first to discover the Oche Dragon house in 1797 and considered it an ancient temple. Several travellers and explorers in the 19th c. describe some of the other buildings (e.g., Wiegand, Walpole, Bursian, Ulrichs, Lecroix, Girard, Baumeister, Welcker).

Some historical accounts for southern Euboea and Styra are found in *Homer* (*Iliad B, 536)* and *Herodotus (I, 146*) *Plutarch* and refer to the ancient habitants of the region as Avantes and Dryopians, both derived from Pelasgians. *Strabo* mentions Lelegians, who may have migrated to Karia (*7.7.12-[321-2*] and 13.1.58-59 [611]). Lelegians are believed to be masons by virtue of their skill with stone as found in the quarries of Hymettos and Karystos in southern Euboea (Radt, 1970; Carpenter & Boyd 1977). This is in contrast to the account of *Herodotus 1.171* (see also, Kourtidou, 1932; Johnson, 1925; Carpenter and Boyd, 1977), who recognises Styrians as a prehellenic tribe of Dryopians that inhabited the area after the Dorian invasions. Another theory is presented by Strabo who attributes the settling of a colony of the Athenian tetrapolis (four cities) of Marathon.

In fact, the first written report of Styra is made by Homer in the Iliad in the "catalog of ships" (*'νηών κατάλογο')* in the campaign against Troia. No archaeological excavations had been carried out at the Dragon houses, with the exception of a small scale dig by Moutsopoulos at the house on the top of Mt. Oche (1480 m.a.s.l.) (Moutsopoulos, 1960. See also Ulrichs, 1842, 1863; Wiegand, 1896). The excavation took place inside and outside of the Mt. Oche Dragon house and produced pottery, clay lamps, charcoal, bones, fragments of bronze vessels and an iron spear head. The artifacts provide a date range from Archaic to Helenistic and Roman times, but according to Carpenter and Boyd (1977) the Archaic finds are not associated with the building itself and are of Hellenistic age.

In 2005, the Swiss School of Archaeology carried out a small scale excavation at the foundation of the Armena fortress (also known as Kastro Larmena) (682 m.a.s.l) near Styra. The fortress was constructed by Eretrians during the 4th c B.C. in order to guard the border with Karystos. Other findings near the fortress date to the 5th c B.C. (Fachard, this volume).

The fortification was partially destroyed during Byzantine and Medieval times and the large blocks were reused in a new fortress. Other findings indicate the use of the fortress in the 15th c A.D. when Euboea was occupied by the Ottomans (Fachard Sylvian, International Symposium on Styria Gaea 2-5 July, 2009, Abstract Book, Dept of Mediterranean Studies University of the Aegean & Municipality of Styra).

Several interpretations have been offered regarding the function and construction of the Dragon houses, e.g., as residence of shepherds or quarrymen, as signaling towers, or as temples (Ulrichs, 1863; *Pausanias* 36, 1 and *Scholiast of Theokritos XV*). In some cases interior architectural remains of a possible altar and artifacts suggested a religious function.

In this paper we approached the date of construction of the structures by applying surface luminescence dating method of monuments introduced by I. Liritzis in 1994 on the actual stone blocks (Liritzis 1994; Liritzis et al., 1997; Habermann et al., 2000; Greilich et al., 2005; Liritzis 2010a, b). The sampling was made on three sites: a) the complex of three Dragon houses at Styra; b) the Dragon house at Kapsala, (both sites have been used by shepherds and quarry workers and are covered with thick vegetation and no archaeological excavation has taken place at either site); c) the trilithon (pi shape) Gate and fortified wall at the Armena fortress (for additional photos, see, Liritzis and Artelaris, 2010, this volume).

SAMPLING AND SAMPLE PREPARATION

Small sized samples were removed from firm contacts between two joining blocks with the aid of a hammer and chisel, gently and efficiently hit to detach a piece with the undisturbed original block surface. It is this surface, presumably exposed to light for a period between the time that the block was cut and shaped and the time that it was placed in the wall and covered by another block, that provides a contact surface untouched by light and thus a resetting of the luminescence clock to zero. The choice of adequate contacts between two joining blocks is guided by visual inspection. The samples are preferably taken from lower courses if possible, or from another part of the wall with no obvious indication of disturbance or rebuilding. Sampling from lower courses near the floor has the advantage of including a higher gamma ray dose rate generated from the sediment floor especially in low radioactivity rocks (e.g., limestones) and more likely represent an original non-repaired or altered part of the building. That is, samples are not taken from an area where possible ancient disturbance might have exposed the block surface to sun light. Care was taken when removing the samples to avoid light: samples were quickly detached and wrapped in black plastic bags. (Liritzis 2010a; Theocaris et al., 1997). Figures 2-7 indicate some of the sampling positions and the type and size of blocks involved. Pieces of 2-3 cm to a side were cut and then replaced *in situ* after removing a couple of mm in laboratory red room conditions from the surface layers.

To avoid possible destruction of the original intact surface each detached piece was separated into more than 2 sub areas and treated as ranges of interest (ROI). An example is shown in Fig.8.

Fig. 2 Laka Palli, sampling at the entrance of the 1st House, 4th sample

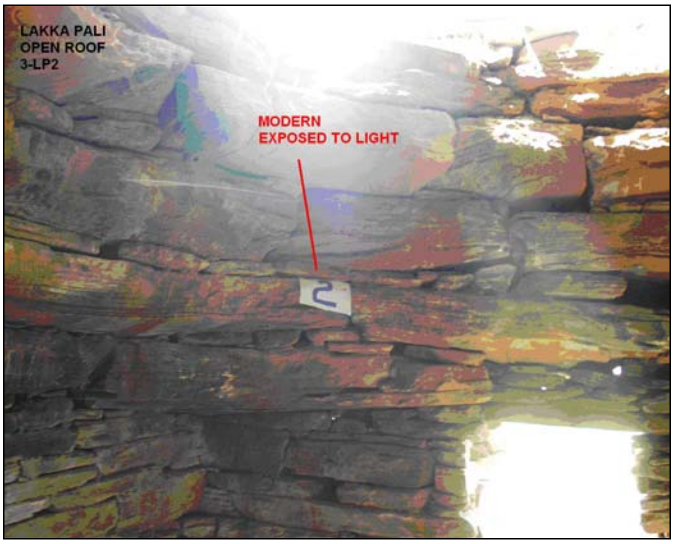

Fig. 3 Laka Palli. Sampling in the open roofed house

Fig.4 Gate of Armena. Sampling at the base

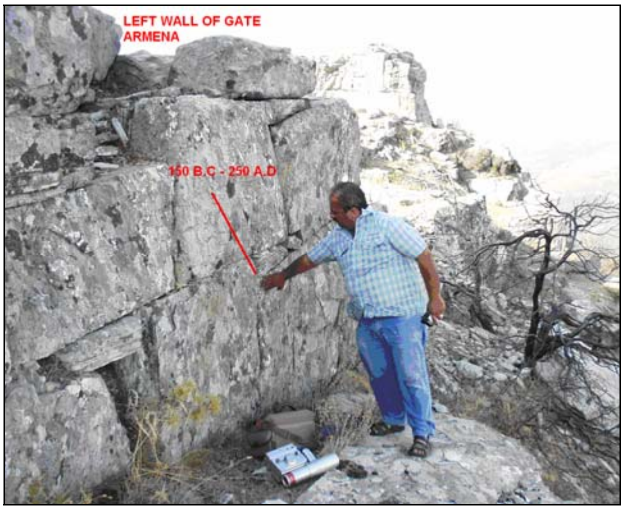

Fig. 5 Fortified wall at Armena, left to the Gate entrance. Sampling and gamma reader.

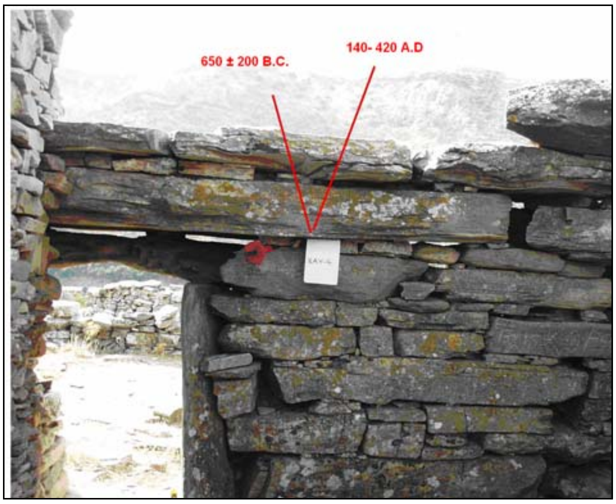

Fig. 6 Kapsala sampling near the top of left entrance interior

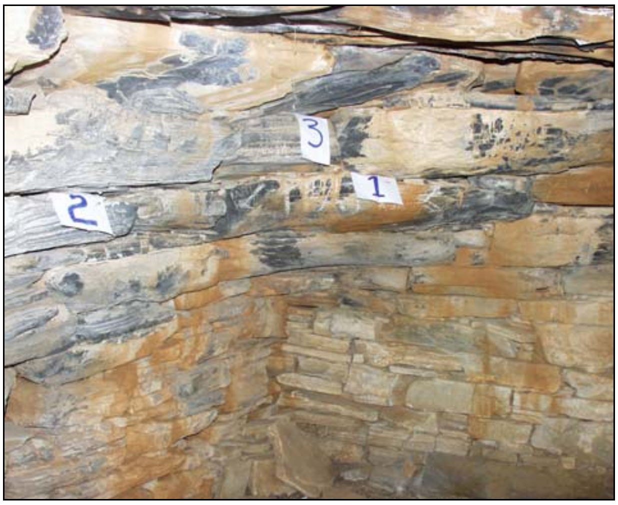

Fig. 7 Kapsala Sampling positions (Nos. 1, 2, 3)

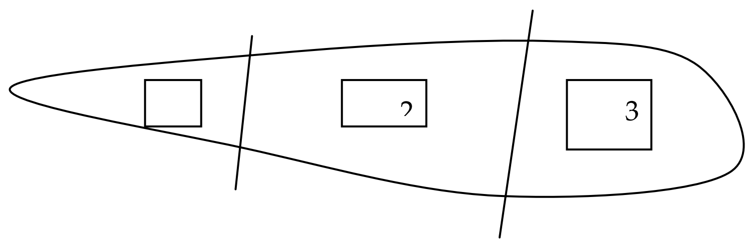

Fig. 8 Kapsala Dragon house, 4th sample, with three sub regions sampled. KAPS4 1, 2 and 3. Scale: length of part 1 is ~0.8 cm. (see Table 1)

All samples were maintained in sealed black plastic bags to prevent sunlight exposure and to retain sample's original moisture. Each sample surface cleared of dirt and any organic or secondary products with quick immersion into diluted HCl acid 0.1% and rinsed with running water. Thereafter, surfaces were gently rubbed with a file to remove layers of powder less than 1 mm thick. These polymineral grains were diluted in HCl to remove calcite, washed in acetone and finally sieved with a ~ 60-150 μm mesh, to gather the quartz.

METHODS AND INSTRUMENTATION

Dose Rates

Potassium determination

FAAS technique (Flame atomic absorption spectrometry) was used for potassium estimation (Flame Atomic Absorption Spectroscopy, Perkin Elmer, USA mod.: Aanalyst 800 Dual System (Flame and Graphite Furnace ionization). The standard procedure was applied i.e. 0.2 gr of sample was transferred to solution in a microwave oven in the presence of 5 ml HF (49%) and 5 ml HNO_3 (69.5%). Thereafter it was diluted to 100 ml. The calibration standard used was SARM 69, from which five solutions of different concentration made the calibration curve. Additional use of Scanning Electron Microscopy (SEM) coupled with energy dispersive spectrometry (EDS) analysis (Philips FEI-Quanta INSPECT with SUTW detector and coupled with EDS PV7760) was made. Quantitative analysis used software EDS-Genesis with errors made via ZAF correction. Analyses were performed in 25 keV with 35^o take-off angle. Detection limits are some decades of ppm while most reliable are those >0.1%. It provided an additional estimation of K distribution and more important, it's topography within the scanned areas; in all samples K was found relatively homogenous within the sample matrix. At least three values were averaged per sample and block. Comparison between SEM and FAAS was made and a calibration curve constructed to reassure precision.

U, Th determination

The uranium-235 (and consequently U-238) and thorium-232 were measured by alpha counting employing the pairs technique assuming U-equilibrium. The alpha counter was a 7286 Low Level Alpha Counter, Littlemore Sci. Eng Co Oxford with a PM tube type EMI 6097B Measurements were calculated by two similar counting systems (at Rhodes and CETI) calibrated in standards following devised conversion factors as well as relevant computations (Aitken, 1985)

In-situ monitoring of the radiation field was practiced with a calibrated portable Tl-doped NaI scintillator unit (SCINTREX, model SPP-2) calibrated within a set of concrete blocks doped with U, Th and K hosted at N.C.S.R. Demokritos

Conversion to dose rates was based on Liritzis and Kokkoris (1992) and Liritzis et al., (2001).

Equivalent dose (D_e) determination

Two OSL readers (model TL/OSL – DA – 15) were used (based at CETI and NCSR Demokritos) operating at identical conditions, simulation was made under blue LEDs light source (λ_p ~ 470 nm, FWHM 30 nm), equipped with a calibrated 0.075 Gy/s $^{90}Sr/^{90}Y$ β-ray source (Bøtter-Jensen et al., 2000) delivering 4.5 and 6.25 Gy/s respectively for the two sets. Heating was carried out using a heating rate of 1 ^{o}C/s, in order to avoid thermal gradient, using a 7.5 mm Hoya U-340 (λ_p ~ 340 nm, FWHM 80 nm) filter. The power level was software controlled and set at 90 % of the maximum power of the blue – LED array, delivering at the sample position ~ 32 mW cm^{-2}.

The D_e was determined on recovered traces of quartz from calcareous schists (Liritzis et al., 2007, 2010).

The single aliquot regenerative – dose (SAR) protocol, introduced by Murray and Wintle (2000) was used in order to estimate the equivalent dose using blue OSL. The blue OSL signals were measured in the continuous wave OSL (CW – OSL) mode for 50 seconds at 125 ^{o}C with the laser held at 90% power. The background OSL levels measured after 45-50 seconds exposure were subtracted from the initial luminescence intensity (0-1 seconds) of the decay curves obtained. Each disc was exposed to infrared radiation for 100 seconds at 125 ^{o}C before of the blue stimulation, in order to reduce the malign influence of feldspars grain to the signal. The procedure is similar to the double SAR procedure of Banerjee et al. (2001), containing additional SAR steps in order to minimize the need for chemical separation. The post-IR OSL signals resulting from polymineral grains are believed to be dominated by the quartz signal. At any rate, all samples were subjected to X-Rays Diffractometry (XRD) scanning prior to any OSL measurement to explore quartz/ feldspar presence.

After the measurement of the natural luminescence signal, each aliquot was given a series of increasing regeneration doses, namely 10, 20 and 40 Gy, in order to obtain a growth curve for each one. The regenerated OSL signal was then measured for three different regeneration doses, including a zero-dose check for the extent of thermal transfer (Aitken, 1998) and a repeat dose point in order to examine the adequacy of the test dose sensitivity-correction procedure. The equivalent dose was then estimated as the dose required producing the natural signal, by interpolating it from the growth curve. The latter was modeled for each aliquot by either a linear or a linear-plus-saturation-exponential growth form.

XRD

Prior to any OSL on marble schists XRD was made to identify presence of quartz and feldspar, for applying the appropriate procedure of total dose evaluation; TL and plateau test for limestone and OSL with SAR for mineral presence. Table 1 shows the XRD results indicating for all variable traces —but large amounts for Gate Armena— of quartz, as well as, albite, dolomite, muscovite, chlorite and mainly calcite

TABLE 1 XRD data for dragon houses and megalithic gate and wall at Armena (Liritzis et al., 2010)

Sample	Quartz	Calcite	Dolomite	Chlorite	Muscovite	Albite
1-LP1	+	++++	Tr	+	++/+	+/tr
2-LP1	tr/-	++++	-	++	++	+
3-LP1	+/tr	++++	-	+++	++	-
KAPS1	Tr	++++	-	++	+++	-
KAPS3	Tr	++++	-	+	++/+	-
KAPS4	+	++++	-	+	++/+	+
2-LP2	tr/-	++++	+/tr	+	++	+/tr
1-LP4	+	++++	-	+	++	-
KAPS6	+/tr	++++	+/tr	-	+	-
3-LP3A	+	++++	-	tr	++	Tr
KAPS5	+	++++	-	+/tr	++	+
3-LP4	+	++++	-	+/tr	++/+	+
KAPS	tr/-	++++	-	-	+	-
LAT2	++	++++	-	++	++/+++	+++
PYARM	++++	-	-	tr	+/tr	-
1-LP	++	++++	-	+++	+++	+++/++
2-LP	++	++++	-	+	++*+	+
3-LP	+	++++	-	tr	++/+	+

++++: predominant, +++: abundant, ++: common, +: few quantities, tr: trace, -: not determined

SOLAR BLEACHING AND PENETRATION ISSUES

Prior to application of SAR technique for the determination of De solar bleaching of polymineral grains and penetration depth of sunshine into the surface was tested. The petrology of all samples is similar but with variable veins presence. When a typical surface of Laka Palli house stone was exposed to light for 20 minutes and 2 hours the remaining OSL per 200 μm layer up to 1 mm shows a remaining dose of around 1 Gy to a depth of 600 μm thereafter exhibits approximately a five-fold increase (Fig.9).

For a longer exposure time of 2 hours from another sample surface, five successive layers 400 μm thick were measured by SAR, as the average of two aliquots from each of the layers. Regeneration doses of 10, 20, 40 Gy were administered, with a test dose of 10 Gy and cut heat at 160 °C. The remaining OSL was 0.2 Gy gradually increasing to 0.8 Gy at depths higher than 1.7 mm depth. It should be noted that the natural signal was very weak.

Obviously quartz in calcareous schists obviates complete quartz resetting clock in a short time as it occurs for sole monolayer of quartz grains. Longer sun exposures ensure complete bleaching (Fig.10), in concordance to earlier literature accounts and theoretical considerations of photon attenuation in rocks with depth (Habermann et al., 2000; Liritzis et al., 1997, Liritzis and Galloway, 1999; Geirlich, 2004; Greilich et al., 2005; Vafiadou et al., 2007; Liritzis, 2010b).

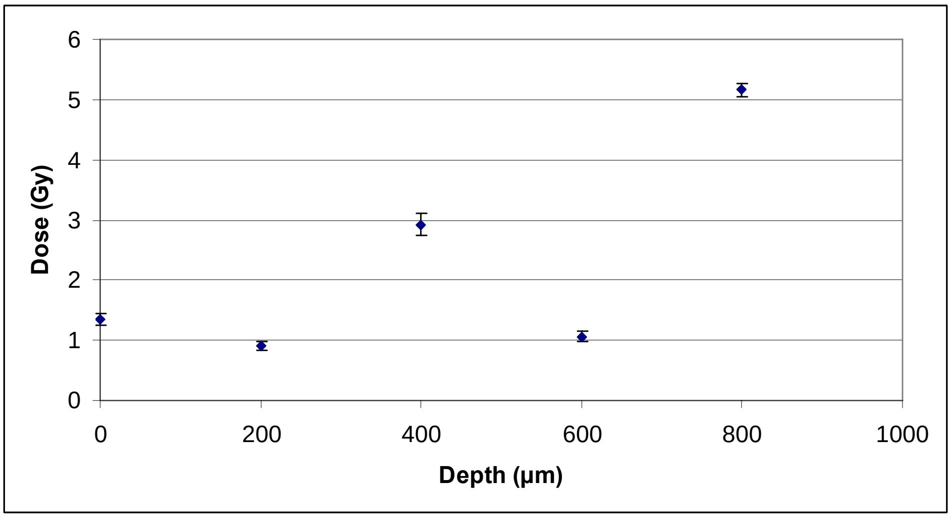

Fig. 9 Laka Palli (LP1) Bleaching of surface by exposed to sunlight 20 mins and removing five layers of ~ 200 μm thickness

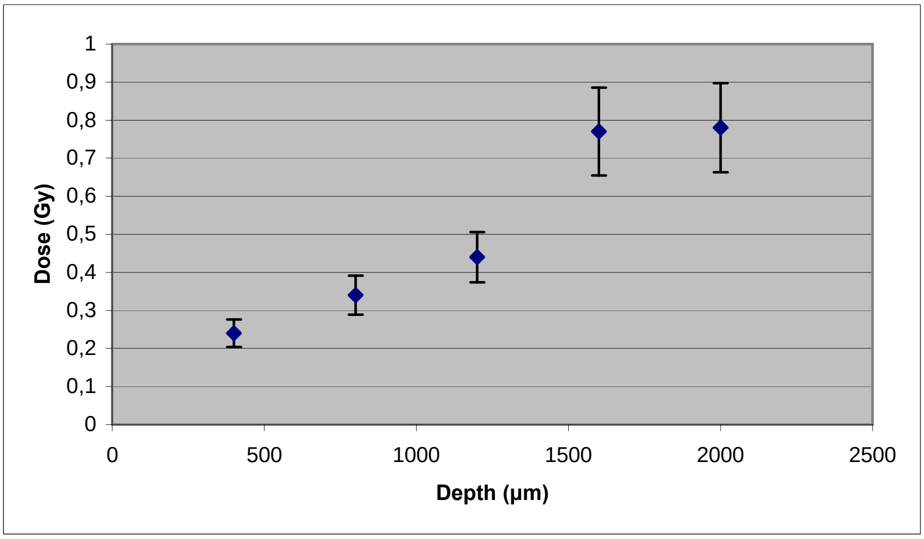

Fig. 10 Kapsala dragon house, exposure of 2 hours to sun. Remaining OSL per 400 μm layer to a depth of 2 mm

RESULTS OF EQUIVALENT DOSE & DOSE RATES PER MONUMENT

Out of 18 samples measured from three sites only 8 gave satisfactory dose results, passing all applied criteria tests (6 from Kapsala, 4 from the 1^{st} Dragon House at Laka Palli, 2 from the 2^{nd} Dragon house at Laka Palli, 4 from 3^{ord} Dragon house at Laka Palli and 2 from the Armena gate and fortified wall (see Figs 2-7).

The tests applied included: dose recovery, bleaching, recuperation, sensitivity change from recycling, fading, and solar penetration tests. Deconvolution of OSL curves and component-resolved analysis was not performed. The reason is that the OSL signals present an extremely rapid decay in the first seconds of stimulation, providing thus a strong indication regarding the presence of a unique fast component, being dominant at the initial part of the OSL curves.

Gate and Wall at Armena

A total of 16 single aliquot discs were measured with SAR giving three dose distributions: 1.19±0.2 Gy (4 discs), 4.75 ±0.5 Gy (8 discs) and 42.32 ± 10.05Gy (4 discs) (Fig.11 a, b, c).

Doses derived from discs of all three samples taken from the base of the megalithic entrance gate and the base of the side fortification wall (i.e no preferred doses from either of the three samples, P1-1, P1-2, P2., was made).

The recovery test, varied ±15% around 1, the recycling 0.95±5%, and recuperation between 3-9%. All measurements followed the IR post-blue mode. From the three doses only the 1.19 Gy is accepted the rest represent presence of geological luminescence (Fig. 12)

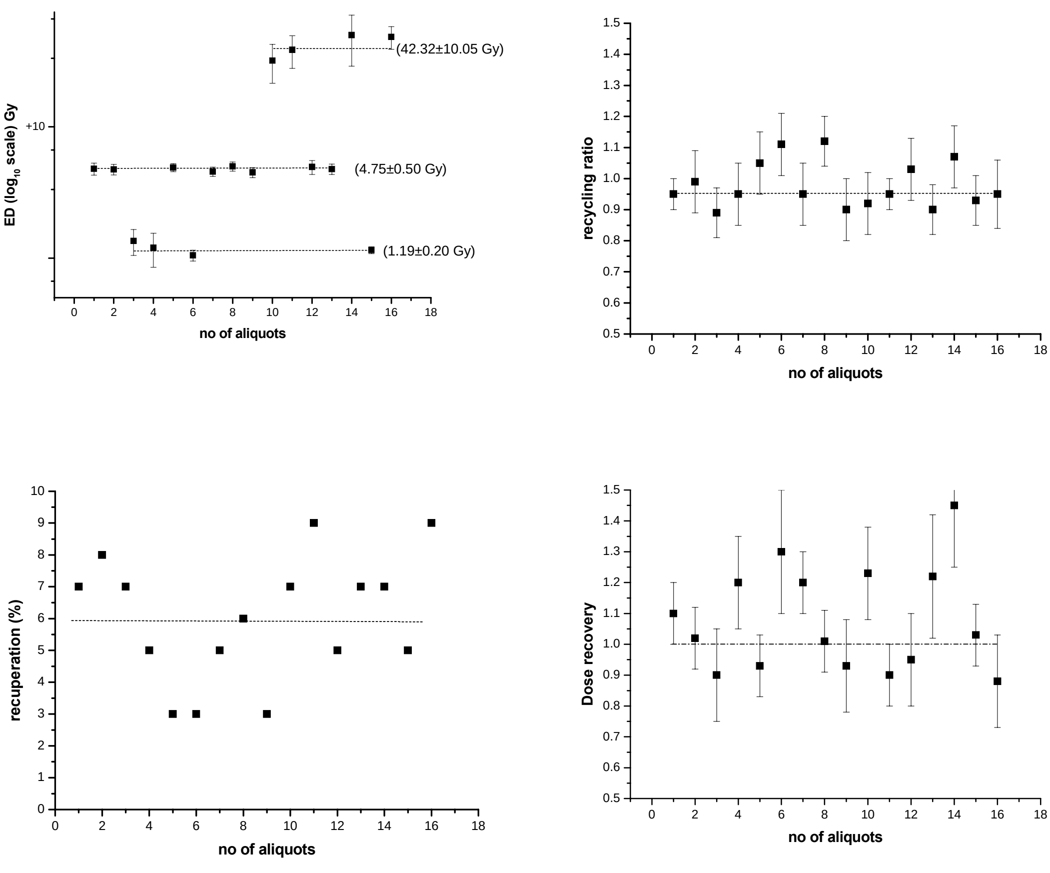

Fig. 11 Equivalent dose distributions (a), recycling ratios (b), recuperation (c), and dose recovery (d), for Pyli (Gate) and fortified wall of Armena

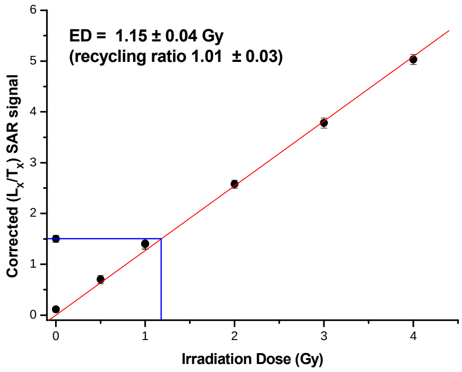

Fig.12. Characteristic SAR-OSL growth curves for ED estimation: the one recovered dose for 'Armena' samples

Dragon Houses at Laka Palli and Kapsala

Some characteristic respective tests for Kapsala and Laka Palli Dragon houses are shown below. Fig. 13a shows a characteristic set of OSL shine curves stimulated by using blue light for 100 secs at 190 ºC, after the signal resulting from feldspars was previously removed by IR stimulation. As it was earlier noticed, all post IR OSL curves are rapidly decaying at the first seconds of stimulation. Fig. 13b shows the effect of different preheat temperatures to the equivalent dose values, the recuperation of the signal as well as the recycling ratio of the repeated regeneration dose. Even though the equivalent dose plateau is formed for low temperatures, preheat temperature of 150 ºC should be rejected due to both extremely high recuperation value (~50%) as well as low recycling ratio (~0.75), while the one of 170 ºC due to high recuperation value. Therefore, the temperature region between 190 and 210 ºC was chosen as the optimum preheat T. This sample gave ED=1.78 Gy. Fig.14 a,b give another recuperation and recycling diagram for Kapsala House as a function of no of aliquots, and Fig.15 (a, b). recuperation and recycling ratios for Laka Palli as a function of no of aliquots.

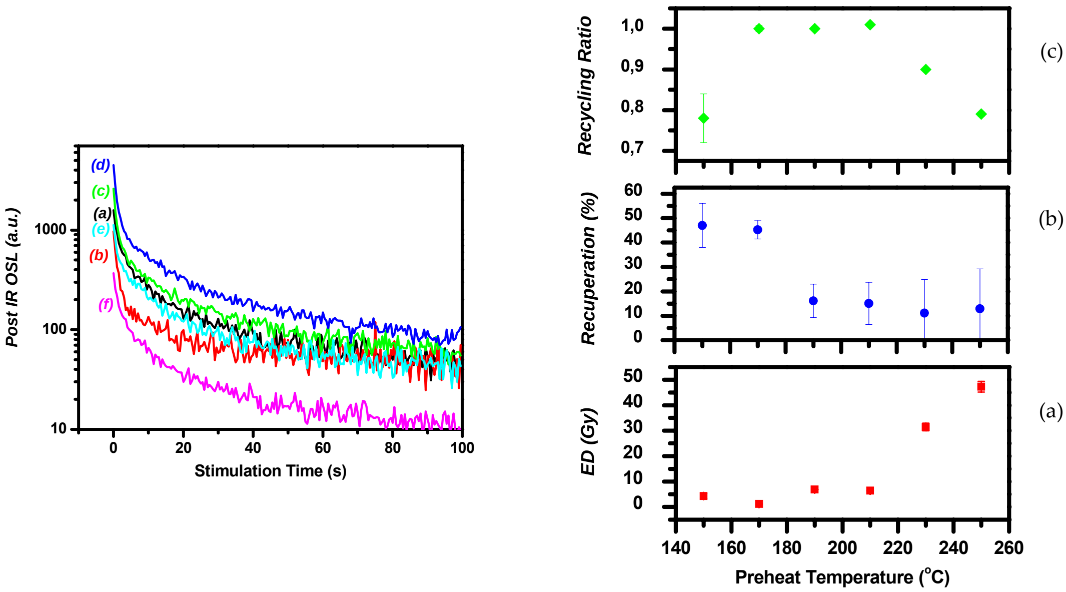

Fig. 13 (a, b) Technical details after measurements at Kapsala sample (Lab code KAPS4.) A (LEFT): Typical post IR OSL decay curves for the natural signal (a), the three incremental regenerative doses, (b, c and d respectively), the repeat dose point (e) and the recuperation afterwards (f), for the first 100 s of stimulation. B (RIGHT): The dependence of equivalent dose (a), recuperation and recycling ratio values (b) on preheat temperature.

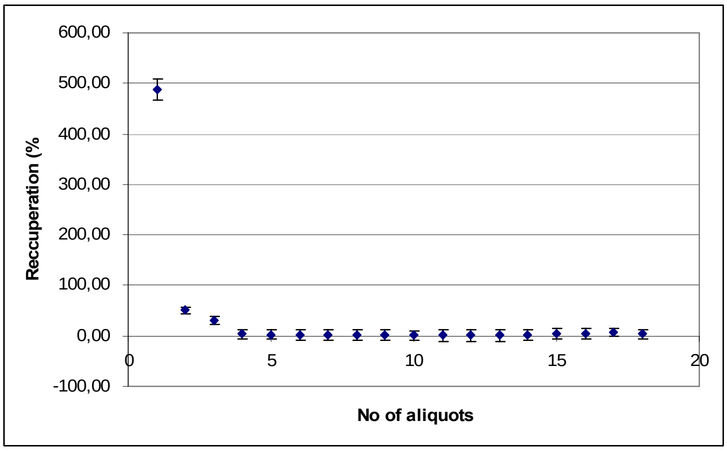

Fig. 14a) Kapsala, recuperation diagram

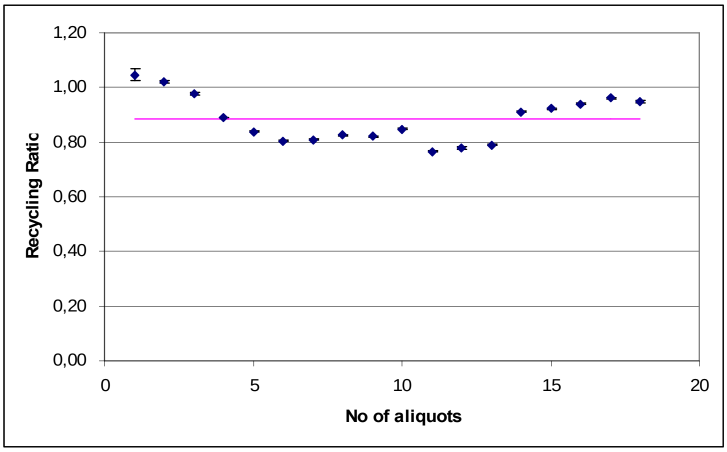

Fig. 14b) Kapsala, recycling ratio (average 0.88±0.02)

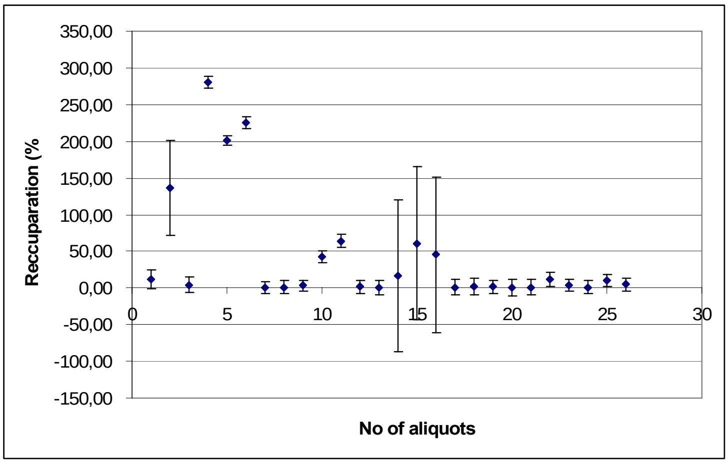

Fig. 15a) Laka Pali, Recuperation

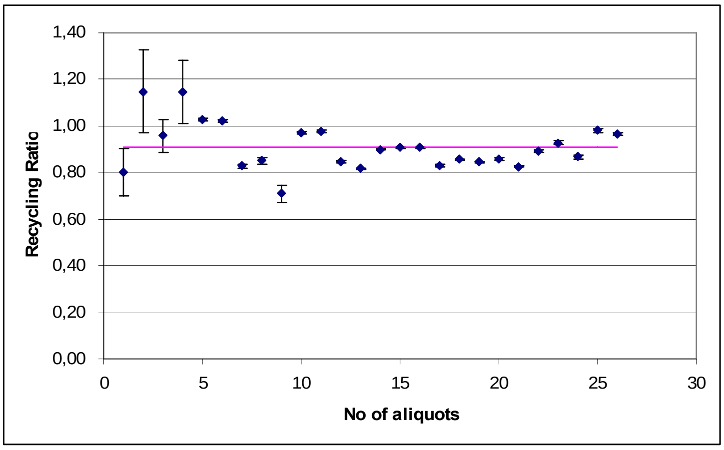

Fig. 15b) Laka Pali, recycling Ratio (average 0.91±0.02)

Table 2 presents the equivalent dose, annual dose and the calculated age. More data were obtained but not included that concern which assess the degree of variation of geological and inappropriate doses, as well as, the micro variation of dose rates within a regional quarry.

Equation (1) provides the OSL age

$$\text{Age (in years)} = De / d \quad (1)$$

Where De = equivalent dose, d= annual dose = $D_a + D_b + D_{g+c}$, D_a= alpha ray dose rates from U, Th, D_b= beta particle dose rate from U, Th, K and Rb of the sampled piece of rock itself, the dated surface occasionally overlaid by sandwiched mortar, but mainly they were in firm contact. D_{g+c} is the gamma-ray dose-rates plus cosmic ray. The grain size selected was 60-180 μm and a beta attenuation factor of 0.95 was applied, no water-uptake is accounted for the rocks, and finally an internal radioactivity of quartz grains of 0.01 mGy/yr and k=b/a ratio of 0.1 are assumed (Liritzis and Kokkoris, 1992; Liritzis et al., 2001; Vandenberghe et al., 2008, Liritzis, 2010; Liritzis et al., 1997).

TABLE 2 Calculated OSL ages, annual dose, equivalent dose, sample code no and site.

SITE	SAMPLE REF No.	TOTAL DOSE, D_e (Gy)	ANNUAL DOSE (mGy/yr)	AGE B.C./ A.D. (calendar years)
KAPSALA	KAPS3	~0	0.76±0.07	Contemporary
KAPSALA	KAPS1	0.53±0.04	0.61±0.06	1245-1030 A.D.
KAPSALA	KAPS4	1.78±0.01	0.67±0.05	650±200 B.C.
	KAPS4 (another piece)	1.16±0.03	0.67±0.05	140-420 A.D
LAKA PALLI	1st House, 1/LP4	0.43±0.015	0.83±0.07	1460-1550 A.D
LAKA PALLI	3rd House open roof? 3LP3A	2.31±0.03	0.947±0.09	430±230 B.C.
LAKA PALLI	3rd House, (another piece), 3LP3	1.60±0.02	0.947±0.09	480-160 A.D
ARMENA	P1, P2 (base of gate and left wall)	1.190±0.02	0.607±0.06	50±200 A.D (150 B.C.-250 A.D)

DISCUSSION

The De were measured with single aliquot regeneration technique at wide preheat temperature ranges (190-210^{o}C) and applying standard criteria tests including Dose-Preheat Temperature Plateau, Recuperation, Fading, Sensitivity Correction due to preheat and shining, Dose recovery. Only those samples which satisfied the tests were accepted.

The division of the detached sample surface, where possible, into more than two sub areas of interest proved extremely important to exclude geological doses and/or partial bleaching, variously disturbed grains of adjacent subareas.

The earlier date is of Classical period and this alone may support the hypothesis of Karian builders left behind after the defeat of Persian kings by Athens and its allies. (Boardman et al., 1988). Moreover, the later dates are supported by historical evidence of re-habitation of these buildings and the fortress.

To elucidate further the obtained dates it is necessary to review the diachronical trend of Styra, including the significant historical events and archaeological evidence that define the region. With this summary the luminescence ages of the Dragon Houses and the Armena fortress are placed in their historical frame.

From the historical reports, ancient Styrians participated in 480 BC in the Salamis sea battle against Persians in 480 B.C. and in the battle of Plataeae, and Styra joined the Athenian league in 477 BC. The OSL dates corresponding to this phase are 430±230 BC and 650±200 BC. In the Lamian war Styra supported the Macedonians against Athens and as a result Styra was destroyed by the Athenian general *Leosthenis*. (Hansen & Nielsen eds, 2004). Styrians were famous for the purple dye industry, but during the Roman occupation their economy was largely influenced by the extraction of marble (the famous Styrian or Karystian stone).

Of particular attraction was the dark green veined marble cipollino, named after the onion (see e.g. Kosso, 1996), which from the 1st c BC to the 3rd c. AD was considered one of the most valuable and widely exported marbles in the southeastern Mediterranean. The OSL dates relative to these activities are 140-420 AD, 150 BC –250 AD.

During the Frankish period the settlement of Styra was situated in its present location on the lower slope of Mt. Kliosi (at 450 masl) below the Armena fortress above. In 1300 AD the Styra region is occupied by the Catalans and in 1373 AD it is sold to the Venetians. Relevant OSL ages are 1030- 1245 AD. The fortress remained in use after the occupation of Euboea by the Ottomans in 1470 AD. The relevant OSL dates for the Turkish occupation are 1460-1550 AD. (Bury, 1888; Norwich, 1996)

Near the Armena fortress on the summit is the chapel of Saint Nikolaos (dating to the beginning of 18th c) and the chapel of Saint Mary (Panagias), build in 1746 AD (as known from inscriptions above the entrance) and constructed on top of an earlier single vaulted Basilika of early the Byzantine period besides a spring. Ancient quarries are dispersed on the slopes of Mt. Kliosi as well as in the surrounding region indicating heavy quarrying during Roman times.

Carpenter and Boyd (1977) correlate and compare the shape, size and construction techniques of Dragon houses with those in Karia of Asia Minor (on the Halikarnassos peninsula) and with one on Mt. Hymmetos in Attica and date them to the Hellenistic period. Carpenter and

Boyd (1977) offer another hypothesis that Darius brought Karians with him to Euboea (*Herodotus, 6.99*) in the campaing against Greece. In fact historians state that Xerxes had in his army Karian soldiers and mariners participating in land and sea battles (*Herodotus. 7.93, 195; 8.19-22, 66, 68, 87-89, 93, 101-106, I33-36; 9.31-32, 107*).

After the defeat of Xerxes a number of Karians may have been left behind. A Karian contingent may have been stranded at Karystos. Prior to the arrival of Themistocles (*Herodotus 8.112, 121*), and after Kimon (*Thucidides, 1.98*), (480-472 B.C.) these isolated group may have contributed to the construction of the Dragon houses(see also relationship of the Apollo Temples in Boeotia and Karia) (Picard, 1952; Steinherr, 1955).

Another interpretation, by Johnson (1925), suggests that Karians, due to political pressure by Rhodos (2nd and 3rd centuries B.C.) immigrated to the Aegean and possibly Euboea (Fraser and Bean, 1954; *Polybius* 2I.24). The coasts of Asia Minor and Karia was Hellenized from early Archaic times and the geographical dispersion of Karians extended from Persia to Rome and from the Black Sea to the Sudan. (Schulten 1936, Launey 1949, Miller 1971).

One issue is certain, the Euboea Dragon houses are peculiar buildings and it is this reason that absolute dating followed by archaeometry approaches, has been attempted. Excavations at the sites of these structures is eagerly awaited.

CONCLUSION

The enigmatic "Dragon houses" in southern Euboea and the megalithic fortress gate at Armena, all built with huge blocks, have been attributed by various ancient or modern historians to pre-Hellenic people (Pelasgians, Dryopeans, Lelegians) or to Karians of later times. The Dragon houses have been hypothetically considered as temples, dedicated to Zeus and Hera, or mere shelters built by quarry workers during Classical to Roman times. However, the dating of Dragon house construction with the surface luminescence dating (OSL) of quartz grains present in the calcareous schist provided ages that define the original construction, as well as, later re-uses. Dates of Classical, Hellenistic-Roman, early Byzantine, Medieval and contemporary times are reported, which are in concordance to the historical and archaeological data.

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