boundary interval. The beginning and the end of the CORBs in the Moldavid units depend thus on various palaeogeographic and palaeoenvironmental settings, and it was controlled by the regional tectonic activity.

An Evaluation of High Resolution Mapping Techniques for Documenting Submerged Archaeological Sites

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The capabilities of robotic vehicles to locate and map submerged cultural sites has drastically improved in recent years. Benefiting from advances in high frequency sonar systems, high dynamic range cameras and the accompanying data processing techniques, the archaeological community now has access to data products approaching centimeter level accuracy over scales of 100's to 1000's of square meters. There are, however, many open issues stemming from the inherent capabilities of acoustic and optical mapping that need to be explored to bridge the gap between what the scientific and archaeological communities expect for quantifying and documenting these often complex sites.

The resolution of the data products is typically spatially varying and affected by sampling density, perspective limitations, surface and sediment characteristics and water clarity. As a result it is often difficult to capture all of the potential errors and distortions in the data products in a clear and repeatable manner.

This paper will present results from several years of field surveys in the Aegean and Blacks seas working at sites in water depths between 50 and 600 meters. Many of these sites were recently located using side scan sonar searching techniques and then subsequently mapped using the Hercules ROV system. The sensor suite for high resolution mapping has included both 675 kHz and 2250 kHz multibeam sonars, a 675 kHz pencil beam scanning sonar, 12bit stereo paired digital still cameras and a 532 nm structured light laser sheet. The accompanying navigation data have been collected during structured surveys with a Doppler velocity log (DVL), fiber optic gyroscope attitude sensor and a quartz crystal depth sensor. These data can be used to create site photomosaics, bathymetry maps and hybrid optical and acoustic texture mapped representations, each of which can be effective as components in a overall site characterization and documentation process.

Using navigation refinement techniques derived from the Simultaneous Localization and Mapping (SLAM) concept common in the robotics community we have been able to create gridded bathymetry maps to half-centimeter spacing with high frequency multibeam sensors and structured light imaging techniques. This level of detail can now enable the accurate measurement of handle sized features on amphorae and detect subtle variations in the sediments around a wreck. Hybridizing this with stereo vision has also provided insight into the shape and textural characteristics of objects as well as the fundamental characteristics of the visual and acoustic sensing modalities. Our challenge moving forward is connecting and enhancing these capabilities in line with the expectations of the archaeological community, while respecting that the primary funding, expertise, and applications for the technology will continue to be in the more established oceanographic sciences. This begins with an assessment of the effectiveness of different technologies for various archaeological objectives, which we define according to the rubrics of identification, characterization, mitigation, investigation, and excavation. Each approach places progressively more demanding requirements on the technology and laborintensive processing to translate the oceanographic data into comprehensible archaeological results. In order for site recording to be worthwhile, therefore, the capabilities and limitations of the technology must be factored into the research design and the archaeological objectives of the expedition. A survey that sets out with the goal

of finding and investigating ancient shipwrecks in a deep water environment must ensure that the tools and techniques available can deliver results that satisfy that rubric, with the benchmarks being comparable expectations for shallow water and land site investigations. We began developing protocols for these different levels of investigation using an overarching methodological rubric of 'nautopsy,' which at this stage is still an evolving and informal way of characterizing the concerns and objectives of recording deep sea archaeological sites.

The growth of regional archaeological survey in the Mediterranean in the last thirty years has been dramatic, and with this growth has come an increasing sophistication in methods and technologies. Procedures for juxtaposing and synthesizing individual survey datasets, however, have lagged far behind. Until this situation changes, the primary value in regional underwater surveys will be the collection of data that do synthesize readily with established knowledge and conventions for representing that knowledge. In the case of an amphora cargo, then, certain precise measurements and observed features (handle stamps, fabric, etc.) of the individual jars provide the key to unlocking the date and origin of the cargo, with minute stylistic changes sometimes enabling the date of a Classical shipwreck to be narrowed to within a quarter century, exceeding the accuracy of radiocarbon dates from the same period. For this level of recording to take place without physical disturbance of a deep water site presents many challenges, both underwater and in the translation of the raw data into the representational conventions of archaeology. This paper confronts the challenges and reviews the achievements of the new site recording technologies in deep water, and proposes guidelines for ensuring that these techniques generate the maximum amount of archaeologically useful data in line with the scientific objectives of the survey.

K-Ar mineral dating and thermochronometry of the south Sithonia plutonic Complex (Chalkidiki, Greece)

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The Eocene Sithonia Plutonic Complex (Chalkidiki, Greece), which intrudes the Circum Rhodope Belt and the Serbomacedonian Massif, is divided into a northern part comprising two-mica (TMG) granites and leucogranites (LG) and a southern part comprising hornblende-biotite granodiorites (HBGD), grading into tonalities (HBTON), and biotite granodiorites (BGD). Abundant mafic microgranular enclaves are enclosed in the granodiorites and tonalites. A mixing plus fractional crystallisation process (MFC) is considered responsible for the evolution of the Sithonia Plutonic Complex. Two end-members are considered, an acid represented by leucogranites and a basic one represented by a lamprophyric-like magma which underplated a lower crust of amphibolitic/basaltic composition. At the early stages of the evolutionary process fractional crystallisation was more active than mixing giving rise to tonalitic/monzonitic enclaves while later on mixing was the prevailing process giving the wide spectrum of composition of the southern part of the complex (HBTON, HBGD, BGD).

The aim of this study is the K-Ar mineral geochronology and thermochronometry of the southern part of the Sithonia Plutonic Complex.

Based on the variety of rock types and their spatial distribution, twenty seven samples (mineral separates) of hornblende (3), biotite (12) and K-feldspar (12) were selected and dated. The K-Ar ages obtained range between 45 and 50 Ma for hornblende, 40 and 46 Ma for biotite and 36 and 42 Ma for K-feldspars respectively.

The K-Ar ages yielded and the published Rb-Sr mica ages are used to investigate the thermal history of the complex. The intrusion of the LG affected mostly the northern part of the HBGD (~46 Ma) and disturbed more the K-Ar isotopic system of the biotite than the Rb-Sr system. The last intrusion was that of the BGD at about 42 Ma. The larger age difference between Bt and Kf and the smaller Kf age in BGD in comparison to the rest rock types along