and frequency of fall events are of more importance. Future climate scenarios are yet to be downscaled, however, expected results are the increased contrast between winter and summer rainfall, and also increasing night-time temperatures (due to increased atmospheric moisture, hence greater cloud cover). This research into stone response to environmental condition will feed into the development of a new model of sandstone decay that considers increased winter wetness and the implications this has for deeper-penetrating moisture (and therefore salts) and increased algal colonisation.

Climate change and wet winters: Testing the diffusion of soluble salts in building stone under saturated conditions

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Controls on stone decay processes are rapidly changing as a result of changing climate. As such, there is a need to understand decay, not just in a dynamic world, but also in a world where the nature of the dynamics themselves are changing. Future climate change scenarios for the northwest of the United Kingdom (NW UK) typically project both increased short-term uncertainty in day-to-day weather conditions and an underlying trend towards wetter, warmer and longer winter conditions. The result of this is that natural stone used in buildings and monuments is wet for long periods of time – over a wet winter, it is possible that entire blocks become saturated. Usually the movement of salts is associated with moisture flux, but this paper investigates an alternative mechanism of salt movement – when blocks are saturated and a concentration gradient is set up, ions must move by diffusion. Because of the increasingly likely scenario of block saturation (in NW UK), this paper proposes a way of testing salt diffusion through natural building stones, modified and refined from studies testing chloride diffusion in concrete, to determine how quickly salts may diffuse through natural stone and any associated deleterious chemical effects. A concentration gradient is set up, whereby salts diffuse through a saturated sandstone sample from a 'cell' containing a 0.55 molar solution to another 'cell' containing de-ionized water. The increase in concentration in the cell containing de-ionized water can be measured at intervals using Ion Chromatography. Preliminary tests have shown that both salt and stone types are important controls for the rate of diffusion. Emphasis is placed on the need to adapt laboratory studies to more accurately reflect the environmental conditions under investigation.

Spatial distribution of salt penetration in weathered sandstone

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This research investigates the importance of the spatial distribution of salts in the weathering process of stone decay. The relationship between salt penetration and the intrinsic rock property, permeability, is examined to elucidate the ingress and egress of salt solution in masonry sandstone. The accelerated weathering trial simulates pre-loading a sandstone block with a 10% salt solution (equal parts NaCl and $MgSO_4$) during a wet winter followed by dried out in summer. Permeability data measured from horizontal slices through the block are correlated with salt data from IC analysis. Results indicate relatively high surface permeability values and salt crystallization on exposure to air. The effect of salts blocking pores and reducing permeability is evident in a reduction in permeability in the near surface

zone where permeability and (sulphate and chloride) salt data are correlated. At greater depth, continual wetting with salt and subsequent heating increases permeability and pore connectivity of the sandstone block. Salt crystallization enlarges and fractures pores, enabling the ingress and movement of soluble chloride salts. The stone's intrinsic properties (permeability and porosity) have been changed by salt weathering, ultimately leading to deterioration and accelerated stone decay.

Age and provenance of Palaeozoic and Mesozoic sediments from Northern Greece: Constraints for palaeotectonic reconstructions

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The Internal Hellenides of Greece are part of the Alpine–Himalayan orogen. The relationships between different pre-Alpine crustal fragments of the Internal Hellenides are now masked by younger (Mesozoic to Cenozoic) complex tectonic and metamorphic events. This, together with the scarcity of biostratigraphic, geochronological and palaeomagnetic data, has given rise to equivocal palaeotectonic models and interpretations. The age and origin of pre-Alpine basement units in the Internal Hellenides has however important implications for our in-depth understanding of the evolution of North Gondwana-derived terranes and consequently for alternative palaeotectonic reconstructions for the Palaeozoic and Mesozoic. A multidisciplinary sediment provenance study was undertaken since sedimentary rocks can provide information about rock lithologies in the source area, which have often been destroyed and recycled during ancient plate tectonic processes. Palaeozoic and Mesozoic sedimentary rocks from key areas of the Internal Hellenides in northern Greece were analysed using whole-rock major- and trace-element geochemistry (XRF, ICP-MS), detrital mineral chemistry (EMP), detrital zircon geochronology (SHRIMP, LA-ICP-MS) and biostratigraphic analysis. In particular, detrital zircon ages are useful to evaluate potential source regions and ancient magmatic events. Furthermore, in the absence of fossil and other stratigraphic data, the youngest grain (e.g. zircon) in a sedimentary rock can indicate a maximum limit for the age of deposition.

Quartzite samples from the Pirgadikia Terrane of the Serbo-Macedonian Massif are correlated with Ordovician overlap sequences at the northern margin of Gondwana on the basis of their maturity and zircon age spectra. The Pirgadikia Terrane can be best interpreted as a peri-Gondwana terrane of Avalonian origin, which was situated close to the Cadomian terranes in the Late Neoproterozoic–Early Palaeozoic, very much like the Istanbul Terrane of NW Turkey. Metasedimentary rocks (e.g. garnetiferous mica schists) from the Vertiskos Terrane of the Serbo-Macedonian Massif probably represent an Ordovician active-margin succession of the Hun superterrane, comparable to successions of the Intra-Alpine terranes.

Clastic metasediment samples investigated from the Circum-Rhodope Belt west of the Serbo-Macedonian Massif belong to the Permian–Triassic Examili Formation, the Early–Middle Jurassic Melissochori Formation (former Svoula flysch) and the early Cretaceous Prinochori Formation. Clastic sediments studied from the Circum-Rhodope Belt of the Thrace region come from the Early–Middle Jurassic Makri Unit and the Late Jurassic–Cretaceous Melia Formation. The rocks of the Circum-Rhodope Belt record Mesozoic rifting, related to the opening of a Neotethyan Ocean, Middle–Jurassic intraoceanic subduction, attendant volcanic-arc magmatism, ophiolite emplacement, and finally oceanic basin closure. Polyphase tectonics and metamorphism complicate palinspastic reconstructions.