Outcomes Postgraduate Conference Attendance Grant to Present Research into The Effects of Ballistic Impact on Stone Weathering

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Summary of Findings for Social Media

This study showed that angle of ballistic impact of a small arms projectile plays a crucial role in controlling fracture density and localisation in stone. These parameters affect the extent of weathering damage after ballistic impact.

Project Summary

This study explored the relationship between angle of ballistic impact and subsequent deterioration of stone due to haloclasty in an arid environment.

Two limestone cubic blocks measuring 15cm x 15cm x 15cm were shot with 7.69 x 39mm ammunition (fig.1). After impact measurements of mass, rebound surface hardness, permeability, and Ultra Pulse Velocity (UPV) were taken. The samples were then cycled through weathering regimes designed to replicate conditions experienced in arid regions. Saturated NaCl solution was introduced at the base of the samples, and they were cycled through 24-hour heating cycles between 20°C and 50°C. The weathering regimes were halted when the samples showed no mass change between consecutive temperature cycles. This was done to replicate the rise of saline groundwater as a weathering process in arid desert environments. The mass, rebound surface hardness, permeability and UPV were measured after the weathering regimes ceased to affect sample mass, to determine the extent of haloclasty deterioration.

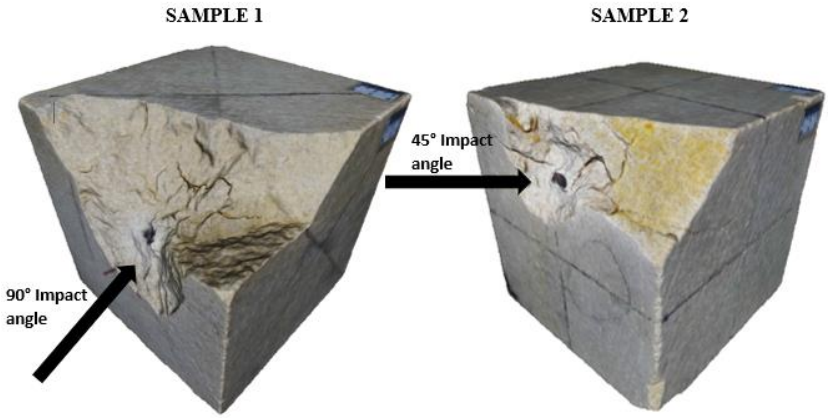

Figure 1: Images showing the damage to the two samples after ballistic impact at differing angles.

Results suggest that angle of impact plays a role in the rate of deterioration of stone after ballistic impact. Direct impact leads to a denser internal fracture network that causes faster saline solution ingress into the block and more severe weathering in the impact crater (as measured through loss of surface hardness). Conversely, angled impact appears to lead to greater weathering weakening outside of the impact crater area. This is an important finding that could aid in prioritising conservation decisions based on impact angle and likely weathering deterioration in the aftermath of conflict damage to stone monuments. These results were published in the proceedings of the conference:

Gilbert, O. Mol, L. Campbell, O. Blenkinsop, T. (2020) The Effects of Ballistic Impact on Stone Weathering, In: Siegesmund, S. Middendorf, B., eds. *Monument Future- Decay and Conservation of Stone, Proccedings of the 14th Internationsl Congress on the Deterioration and Conservation of Stone,* Gottingen, Germany, 7th-12th September, 2020, Mitteldeutscher Verlag GmbH, Halle (Saale), pp.309-315.

Use of BSG Grant Funds

The BSG Postgraduate conference award of £500 was to be used to cover travel and accommodation costs to travel to Gottingen, Germany, to present this research at the Stone 2020 conference. Unfortunately, the conference was cancelled due to the COVID-19 pandemic. The organisers of the conference provided a copy of the compiled proceedings, at a cost of €160 (£145.07 at time of writing). The remaining £354.93 was not spent and has been returned to the BSG.