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Rock Coasts on the Move: Boulder morphodynamics during the March 2008 storm, Wales UK

Larissa Naylor (1), Wayne Stephenson (2), Helen Smith (3), James Mendelssohn (4), and Andrew Cowley (1)

(1) School of Geography, University of Exeter, Cornwall Campus, Penryn, Cornwall, TR10 9EZ, l.a.naylor@exeter.ac.uk, (2) Department of Geography, University of Otago PO Box 56, Dunedin, New Zealand, (3) School of Engineering, University of Exeter, Cornwall Campus, Penryn, Cornwall, TR10 9EZ, (4) Head of Biology and Earth Systems, Atlantic United World College, St Donat's, Llantwit Major, Wales, UK, CF61 1WF

There is growing research suggesting that coastal boulders can be entrained, transported and deposited by storm events as well as tsunamis. This research has typically documented decadal to century timescale changes in intertidal, supra-tidal or cliff-top boulder deposits. Indeed, there are no known studies of contemporaneous boulder transport studies in coastal environments (Goto et al., 2009). The nature of boulder transport mechanisms and modes during storm events is therefore unexplored. Researchers have suggested possible modes of transport, including rolling, sliding, flipping, or carried in suspension. These have yet to be observed during storm events.

This paper presents the first-known dataset of intertidal boulder morphodynamics during a storm event. We present daily data from the 9th-13th of March 2008, capturing pre-storm, storm and post-storm boulder positions. Field data on boulder position was collected using a differential GPS, alongside observations of boulder position, orientation and boulder size. Data were plotted in GIS, and using a series of python scripts were analysed to measure distance and direction travelled. Wave data from Turbot Bank buoy was modelled using SWAN. These data plus tidal records were compared to the field measurements of boulder movements, to identify relationships between wave force and measured boulder movements.

The majority of boulders sampled were entrained and transported during the 3 day storm event, with one boulder having moved over 60 metres during the storm. Daily observations also enabled us to draw conclusions about the various modes by which boulders were transported. Some were flipped, others were carried in suspension, whilst more slid or were rolled across the shore platform surface. Three new boulders were detached during the storm event, on two separate days. Boulder breakdown was also observed and quantified. Results show that daily data enabled us to better understand and quantify boulder morphodynamics. For example, one boulder moved a total distance of 40 metres when measured at the start and the end of the storm, but actually moved over 60 metres when daily measurements were totalled.

These data therefore provide the first quantitative evidence that intertidal boulders can be repeatedly entrained, transported and deposited during a multiple day storm event. The scale of the boulder movements over a single storm event also demonstrate that rock coasts can be far more dynamic than hitherto considered. More work is required to determine how widespread these morphodynamic responses are. Given that extreme storm events are likely to increase under an altered climate regime, the morphodynamic response of boulders measured during the March 2008 could become increasingly common.

Reference:
Goto, K., Okada, K., Imamura, F. 2009. Characteristics and hydrodynamics of boulders transported by storm waves at Kudaka Island, Japan. Marine Geology, 262, 14-24.