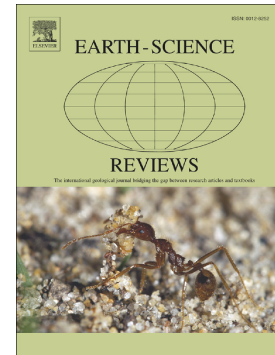


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# Geological hazards in the UNESCO World Heritage sites of the UK: from the global to the local scale perspective

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## Abstract

UNESCO World Heritage List encompasses over 1,000 cultural, natural and mixed World Heritage Sites (WHS) with outstanding universal value. Many of these sites are faced with geological threats which could have negative effects on the value, integrity and accessibility of their heritage assets. Assessments of geological hazards susceptibility are still limited in the literature and mostly undertaken at global to continental levels. The paucity of nationwide exercises that could be carried out based on the wealth of established datasets and models available at the geological surveys proves that there is not yet a systematic Earth-science approach applied to heritage conservation. Focusing on the WHS of the UK, this paper aims to: (i) appraise the suitability of existing geohazard mapping approaches at global to continental scale, and whether an assessment at finer scale is instead required; (ii) review nationwide geological datasets available, developed and maintained at the British Geological Survey (BGS), and provide the first quantitative assessment of the full spectrum of geological and mining-related hazards affecting WHS across the country; and finally (iii) explore how such a review can fill knowledge gaps and increase awareness of geohazards in the national WHS management sector. An assessment of hazard information from published global and European scale studies using low to medium spatial resolution hazard datasets is first provided. The review then moves to the national level and reaches the scale of the individual WHS, accounting for the extent of their Core Area, Buffer Zone and Sensitive Area as designated by UNESCO, and their geological and geohazard peculiarity. We analyse the whole spectrum of BGS datasets, including: six *GeoSure* ground stability products, aggressive ground conditions from *BGS Civils*, the National Landslide Database, mass movement deposits from the Digital Geological Map of Great Britain (*DiGMapGB*), fluvial and coastal Geological Indicators of Flooding (*GIF*), and susceptibility to Groundwater Flooding (*GWF*). Mining data from *BGS Mining hazard (not including coal)*, *British Pits (BritPits)*, as well as ARUP's review of mining instability and opencast coal data from the Coal Authority are also analysed. The review reveals that ground compressibility and uneven settlement (subsidence) and landslides are the geohazards that, with higher likelihood, may affect the integrity of the UK WHS. These geohazards show the highest percentages of total susceptible land (18.6% and 11.5%, respectively), followed by corrosive (ferrous) ground conditions (11.3%), groundwater flooding at surface (14.3%) and below ground (9.7%), liquefaction of sand deposits (10.9%) and mining hazard (8.0%). These figures highlight the granularity and diversity of the geology and hazards found across the country, as well as the improvements compared to global and continental approaches. The priorities

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