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Introduction

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The Global Heritage Stone initiative aims to establish a new formal international geological designation for important types of natural stone that have been widely used and/or have widespread cultural and architectural recognition. The initiative also aims to develop internationally accepted formalization of the reporting of specific characteristics of natural stone used for repair and maintenance of historic buildings, monuments and areas, as well as for new construction. Papers in this first Global Heritage Stone volume have been sourced from contributions to a session on Heritage Stone that was held as part of the European Geosciences Union General Assembly in 2013 supplemented with contributions from other authors who are enthusiastic about this concept. This book is an additional contribution to studies on the currently important issue of natural stone use in architectural heritage. It complements previously published Geological Society Special Publications on related topics such as:

- SP205 Natural Stone, Weathering Phenomena, Conservation Strategies and Case Studies (Siegesmund *et al.* 2002);
- SP271 Building Stone Decay: From Diagnosis to Conservation (Přikryl & Smith 2007);
- SP331 Limestone in the Built Environment: Present-Day Challenges for the Preservation of the Past (Smith *et al.* 2010);
- SP333 Natural Stone Resources for Historical Monuments (Přikryl & Török 2010);
- SP391 Introduction to Stone in Historic Buildings: Characterization and Performance (Cassar *et al.* 2013).

This volume commences with general contributions by Cooper (2014) and Marker (2014) which, respectively, propose and discuss the criteria and procedures for defining a Global Heritage Stone

Resource (GHSR) and a Global Heritage Stone Province (area containing two or more GHSRs). Both emphasize the need for international agreement and careful thought before any proposed stone is given the proposed new status. These are followed by nineteen papers that describe different natural stones that are recognized for their importance in architecture, and cultural and historical heritage, and consider the extent of their use around the world.

Four natural stones from Spain are discussed: Martinamor granite (Pereira *et al.* 2014), Sierra Nevada serpentinites (Navarro *et al.* 2014), Villamayor sandstone (García Tiegón *et al.* 2014) and Colmenar limestone (Fort *et al.* 2014). Three of these contribute significantly to the architectural heritage of specific Spanish cities. Most buildings in historic Salamanca, a UNESCO World Heritage city, were built of Martinamor granite but this is no longer extracted. Formal recognition of this stone might help to ensure that the quarry is protected for possible future use, perhaps with interim restoration, instead of disappearing like many other disused quarries. Sierra Nevada serpentinite was used in many historic buildings around Spain, mainly for interior work, because this stone suffers a high degree of weathering if used externally. Proper characterization will assist in identifying appropriate materials for repair and maintenance of buildings of cultural importance. Colmenar limestone has demonstrated high durability in many buildings of historic Madrid. Its extensive use, coupled with its durability, makes it another strong candidate as a GHSR from Spain.

A serpentine marble from Sweden, the Kormarden marble, is described and proposed as a GHSR by Wikström & Pereira (2014). It has been used for many years in construction of many major and

famous historical buildings around the world. Continuing availability for restoration and new construction is needed.

Estremoz marble and Oporto granite are featured as examples from Portugal. Estremoz marble is a widely known stone that has been exported to many different countries. **Lopes & Martins (2014)** present its properties, which are variable, making variants suitable for a range of different uses, both on exteriors and interiors of buildings. Therefore it is important to characterize the variants properly to ensure that stone being supplied is suitable for specific construction and/or restoration uses. The paper discusses those characteristics. The Oporto granite was used extensively in that city, which now has UNESCO World Heritage status. **Almeida & Begonha (2014)** characterize the granite and propose it as a GHRSR, as well as alerting the scientific community to the worrying deterioration that is observed in parts of buildings due to specific climatic conditions at Porto.

In Brazil, historic stone built cities were located mainly on the coast or in parts of the eastern interior. Because of large distances and limited transport, stone was usually quarried locally, leading to a considerable diversity of types being used, ranging from calcareous rocks to granites and gneiss. Unusually, steatite and schist have often been used, and these are proposed as possible candidate GHRSRs by **Costa (2014)**.

If there is a single stone that has become widely known internationally for beauty and its good construction performance, it is probably larvikite from Norway. The bluish colour and iridescence are familiar in many parts of the planet, making it of global significance. **Heldal *et al.* (2014)** also demonstrate that the extraction of this material illustrates good quarrying practices. Hallandia gneiss from Sweden is another much used natural stone that is still required for maintenance and repair purposes but the resource is limited to a relatively small area where there are strong competing land uses (**Schouenborg *et al.* (2014)**). This is a cause for serious concern among Swedish construction companies. Nomination as a GHRSR might help to secure the future of supply of this important material.

Golež & Mirtič (2014) consider the stone heritage of a region in Slovenia, drawing attention to abandoned extraction sites that should be preserved as historic quarries to guarantee continuing supplies of materials for restoration and renovation of the deteriorating architectural heritage in some parts of the country. **Kramar *et al.* (2014)** focus on Podpeč limestone; the principal national stone from Slovenia. The main quarry is now inactive but is recognized as a protected geological site of national importance. However access for future extraction is needed for repair of historic buildings.

In Italy, natural stone has been considered as a piece of art in its own right. This book contains five examples of very different stones from Italy that are proposed as GHRSRs. **Dino & Cavallo (2014)** describe a proposed project that aims to preserve historical memories of the stone industry of the area between the Ossola Valley of Italy and the Canton Ticino in Switzerland. **Borghi *et al.* (2014)** describe the natural stones that can be found in the 12 km of interconnecting monumental arcades of Turin, which comprise the widest city promenade in Europe. Other examples of Italian natural stones discussed in this book are Carrara marble, Pietra Serena sandstone and Rosa Beta granite. Carrara marble is world famous and has been used in most applications from architecture to sculpture, urban landscape and funerary art. Many world famous artists used this material, leaving magnificent works of art for the world to admire in many internationally important museums as explained by **Primavori (2014)**. Pietra Serena is a carbonate-cemented sandstone that contributed to the beauty of Florentine Renaissance architecture. **Fratini *et al.* (2014)** demonstrate how some delicate natural stones were correctly chosen for durability by past architects. Rosa Beta granite, a pink granite from Sardinia, has been used in architecture since prehistoric times. It is now found in buildings in all continents and is, therefore, of international importance, as shown by **Careddu & Grillo (2014)**.

Piedra Mar del Plata is one of the few natural stones from Argentina that has been used in construction. **Cravero *et al.* (2014)** describe how this quartzite was used in the 20th century to develop an important architectural style for middle class families, in contrast to elaborate mansions for the upper classes that were constructed using imported stones. Piedra Mar del Plata therefore contributes significantly to local distinctiveness.

Stones used for Russian classical and baroque style buildings in St. Petersburg are described in a paper by **Bulakh (2014)**. These were obtained from the north-western part of the Russian Empire in the 18th and 19th centuries while modernist-style buildings of the 20th century used stones from other parts of Europe.

Overall, the papers demonstrate a considerable diversity of types and uses of natural stone. Use over long periods has contributed to local character and distinctive architectural styles that have become sources of national pride. A continuing supply of these materials is required for appropriate repair and maintenance of historic structures, as well as for new buildings. But many of the quarries from which stone has been obtained are closed or are under pressure from competing land uses. These need to be safeguarded and GHRSR status might

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help to convince planning authorities that access should be retained.

There are many stones that are likely to be proposed for GHSR status variously on historical, architectural, archaeological or artistic grounds. Some structures already have a degree of international recognition through World Heritage status or are protected through national designations. Some types of stone have been used widely around the world, but others of great architectural significance have been used only in geographic proximity to the extraction site. Assessing the significance of diverse factors will require care before any GHSR or GHSP designations are approved.

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