
*Comment**

Comment on “Model of limestone weathering and damage in masonry” by P. Gatt, Xjenza vol. 11 (2006).**Jo Ann Cassar*****Institute for Masonry and Construction Research, University of Malta, Msida MSD 06, Malta***Keywords:** *Globigerina Limestone, deterioration, model, characterization**Received:* 21 January 2007

In his paper, Gatt suggests “a model for fine-grained limestone e.g. Globigerina limestone... based on the nature of the stone and the related mode of weathering ... independent of salt load, which is a function of the environment.” He also adds that “it is the mode of weathering which reflects the intrinsic nature of the stone, independently of environment...”. These statements in effect run counter to a corpus of knowledge on stone deterioration (Schaffer, 1932; Price, 1996; Ashurst and Dimes, 1998; Delgado Rodrigues, 2001; Lazzarini, 2002) and including also work quoted by Gatt (e.g. Fitzner et al., 1997), in that no matter what the intrinsic properties of a stone are, the amount of damage and the mode of weathering will always also depend on the surrounding environment; a case in point is the moving of archaeological remains to indoor (and hence sheltered and milder) environments, to slow down deterioration. Hence, the attempt to develop a model for weathering *independent* of the environment appears to be misdirected.

The line of research undertaken by Gatt should have also taken into account not only these studies on the deterioration of stone, but also all the empirical studies on Globigerina Limestone which have been conducted locally over the years. The latter has included research on the deterioration of Globigerina Limestone, as well as studies on the chemical and physical properties of Malta’s building stone. These studies have dealt with the characterization of Globigerina Limestone, and have also included an intriguing line of investigation: that of whether the geochemical composition of the insoluble part of Lower Globigerina Limestone can be used to distinguish the durable “franka” from the less durable “soll” This work started with a dissertation by Testa (1989), quoted by Gatt, and culminated in a paper by Cassar and Vella (2003) (not cited by Gatt). In the intervening period, several other dissertations on the subject were written, some of which resulted in a publication by Vella et al. (1997), published in *Xjenza*. All of this work has clearly pointed to the fact that the geochemical composition of the insoluble fraction of the Lower Globigerina Limestone can be used to help identify “good” from “bad” stone. A complete list of these, as well as other related dissertations, and published

papers on Globigerina Limestone, can be found in a paper by Cassar (2004) entitled “Composition and property data of Malta’s building stone for the construction of a database” in a publication by Prikyl & Sigel. A partial list is given below.

Gatt, in his paper, does make reference to another paper by Cassar (2004) entitled “Comparing visual and geochemical classification of limestone types: the Maltese Globigerina Limestone”. Here, however, Gatt attempts to undermine the sum total of the geochemical work done over the years on Globigerina Limestone, by stating that “Cassar (2004) alleges that marginal non-carbonate geochemical parameters can be used for ‘predicting’ severity of weathering” and “the slight non-carbonate content... has no consequence on salt weathering.” This line of reasoning appears to be contrary to the scientific evidence available to date.

The most succinct way the geochemical information, together with the mineralogical and physical data, as well as information on salt weathering of Globigerina Limestone (including, but not only, that given by Fitzner; see also list of publications given below) are to be interpreted maybe be found in Cassar 2002.

Quoting from the abstract of this paper should greatly clarify matters:

“The Globigerina Limestone occurs as two types of building stone: the resistant ‘franka’ and the easily weathering ‘soll’. Research on both fresh and weathered samples has led to an understanding of the main differences in these two types of stones. The causes and mechanisms of deterioration have also been established. ‘Franka’ and ‘soll’ differ in geochemical and mineralogical composition and in physical properties. The ‘soll’ is richer in the non-carbonate fraction, which occludes some of the pore space, resulting in a lower overall porosity and a higher proportion of small pores. The ambient local environment, heavily loaded with sea salt, particularly sodium chloride and sulphates, readily induces deterioration in ‘soll’, whereas ‘franka’ tends to resist better in this aggressive environment. The weathering process of Globigerina Limestone in general

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has been explained as a sequence of steps, from the formation of a thick and compact superficial crust, to the loss of this crust, to the initiation of alveolar weathering. Understanding the deterioration mechanisms of Globigerina Limestone permits criteria for proper conservation treatment to be established."

However, Gatt states that because "a casual relationship between slight non-carbonate mineral content (e.g. non-swelling kaolinite) and severe weathering forms seen in masonry" was not found, this leads to "eliminating the relevance of geochemical proxies used by Cassar (2004) in "predicting" weathering in Globigerina Limestone." However, the observation that a relationship was not found in itself does not preclude the fact that it does exist. Cassar and Vannucci (2001), state that "the intrinsic clay fraction which, although small, contains minerals such as smectite and illite-smectite which are highly expandible", are hence "other factors that affect this deterioration process". Papers by Vannucci et al. (1994), Vella et al. (1997), Cassar and Vannucci (2001), Cassar (2002) and Cassar (2004), also make it clear that the mineralogical and/or geochemical compositions are in fact important players in the weathering behaviour of the stone. Linking once again the geochemical, mineralogical and physical, Cassar (2004) states that "as "soll" limestone has higher concentrations of phyllosilicates and quartz, it is hypothesised that some of the pore space in this type of stone is occluded by this non-carbonate fraction" which then may give rise to the difference in the intensities of weathering of the two stone types.

Even the use of the words 'franka' and 'soll' appear to be problematic to Gatt, who states that "an obstacle to the scientific study of Globigerina deterioration is the persistent use in literature of elusive vernacular terms utilised by masons and quarrymen..." It is unfortunate that Gatt thinks this, as in actual fact much of the interest in this work is also, but not only, amongst workers in the building trade, and is due to the fact that this scientific work takes cognizance of the vernacular and as such is richer for having done so. Moreover, what the quarry workers, and builders, have been saying for centuries, is now being substantiated by current research.

In his paper, Gatt borrows extensively from the work by Fitzner, especially his 1997 paper entitled "Model for salt weathering in Maltese Globigerina Limestone" but omits the paper by Vannucci et al., 1994, although Fitzner himself makes reference to this earlier paper, which, for the first time, describes the mode of weathering of Globigerina Limestone.

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