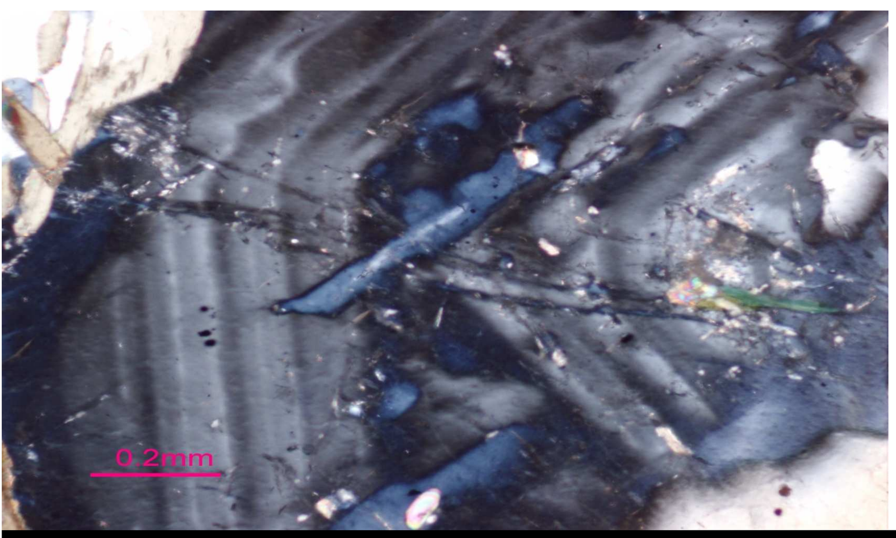

characterization of the concrete alkali reactivity of granitoid and dolomitic aggregate

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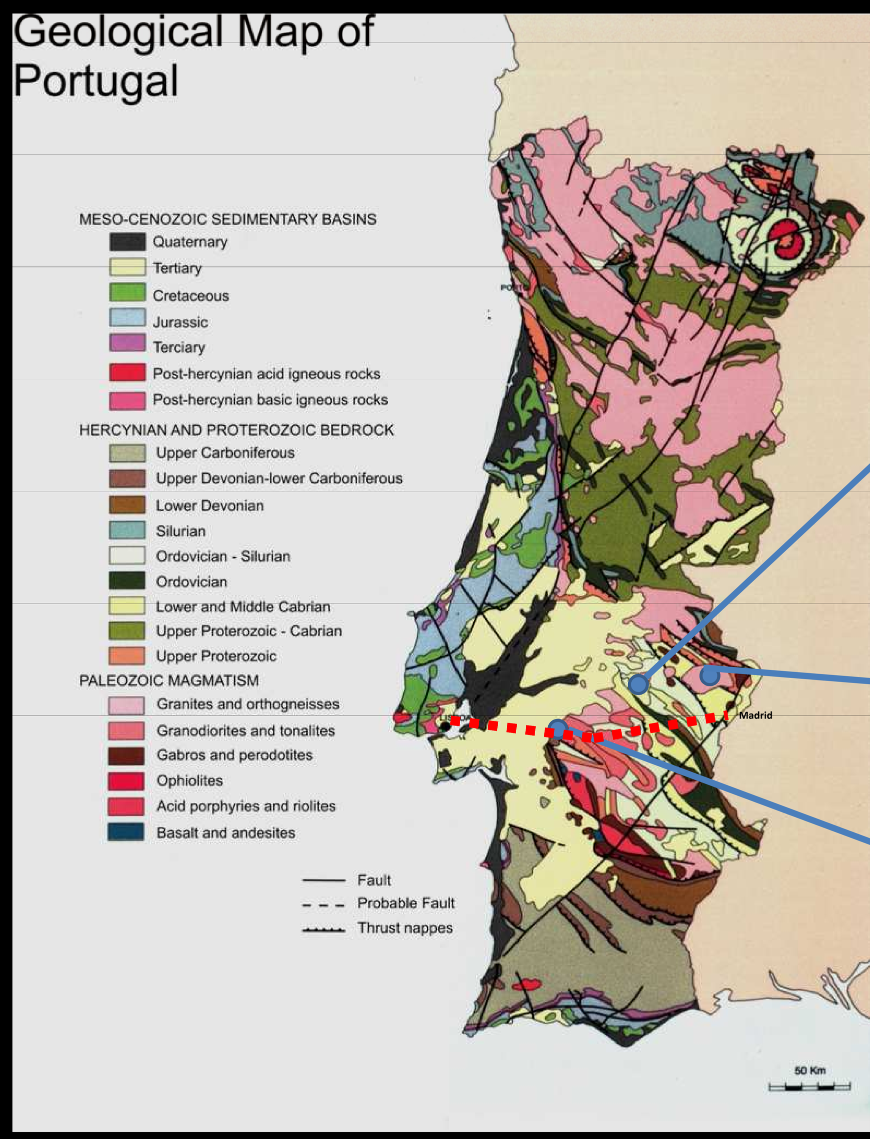
1. Introduction- Internal expansive reactions

Internal expansive reactions include the *alkali-silica reaction* (ASR) and the internal sulfate attack with delayed ettringite formation (DEF). These reactions are characterized by the formation of expansive compounds in hardened concrete and consequent cracking of the structure.

Previous research has shown that the use of some aggregates, initially regarded as inert, can cause problems, proving the need for further insight on the role of aggregates and prevent the occurrence of ASR in constructions. In this work we investigated the influence of different types of aggregates from three quarries in Southern Portugal.



2. Sampling

Three quarries were chosen given the proximity with the recently approved Lisbon-Madrid High Speed Train railway (dashed red line in map), size and aggregates variability.

Cano - Dolomite

The dominant lithology in the Cano Quarry is a recrystalized dolomitic-limestone intruded by a (~5m thick) dioritic dyke. The carbonate rock, on outcrop display several colours/textures that reflect mainly differences on the granularity size and minor minerals contents.

Santa Eulália - Granite

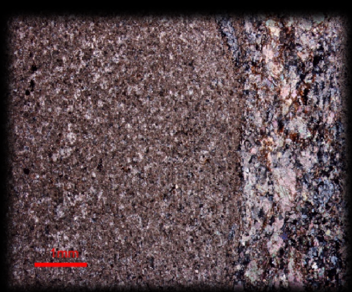
The dominant lithology in the Santa Eulália quarry is a granitoid (two-micas leucogranite) with an isotropic texture.

Montemor - Granite

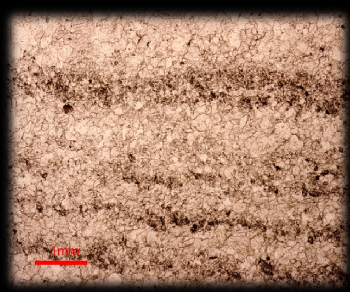
The dominant lithology in the Montemor quarry is a granitoid (tonalite) with an anisotropic texture given by the alignment of ferro-magnesium (dark) minerals and microdioritic enclaves.

3. Aggregates Characterization

3.1 Petrographic description



Cano - Dolomite



Mineralogy: calcite, dolomite, quartz, biotite (rare). The distinction between the two carbonates was performed with DRX and SEM-EDS.

Textural features: recrystalized dolomitic-limestone shows a dominant granoblastic texture with a small grain size < 0.5mm. The quartz grains are usually spatially associated with small grains of dolomite. The quartz, as other minerals, doesn't show evidences of plastic deformation.

Dioritic dyke: Mineralogy plagioclase, amphibole, quartz and biotite. Textural features: hypidiomorphic granular and shows a medium grain size. The rock shows the widespread secondary growth of chlorite as well strong evidences of alteration on feldspar. No significant plastic deformation was observed.

Santa Eulália - Granite

Mineralogy: plagioclase (oligoclase-andesine), microcline, pertitic feldspar, quartz, muscovite and biotite . Accessory phases apatite and zircon; secondary phases chlorite and sericite.

Textural features: hypidiomorphic granular with a medium grain size (1mm to 1.5mm). Some of the biotite are partially or totally replaced by chlorite. The rock reveals strong signals of alteration, manly by the sericitization of feldspars. Although a slightly undulose extinction in quartz no plastic deformation was recognized.

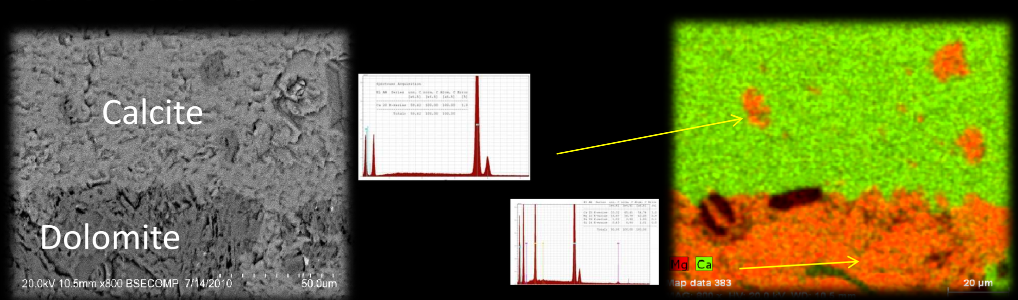
Montemor- Granite

Mineralogy: plagioclase (andesine), quartz, amphiboles (Ca and Fe-Mg amphibole) and biotite . Accessory phases apatite and zircon; secondary phases chlorite and sericite.

Textural features: hypidiomorphic granular with a medium to coarse grain size (1 - 2mm). Although weak sericitization on feldspar the rocks is very fresh. Although a slightly undulose extinction in quartz no plastic deformation was recognized.

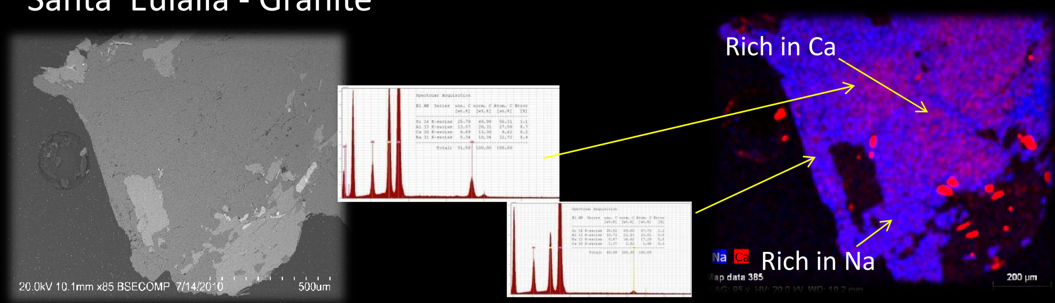
3.2 SEM

Cano- Dolomite



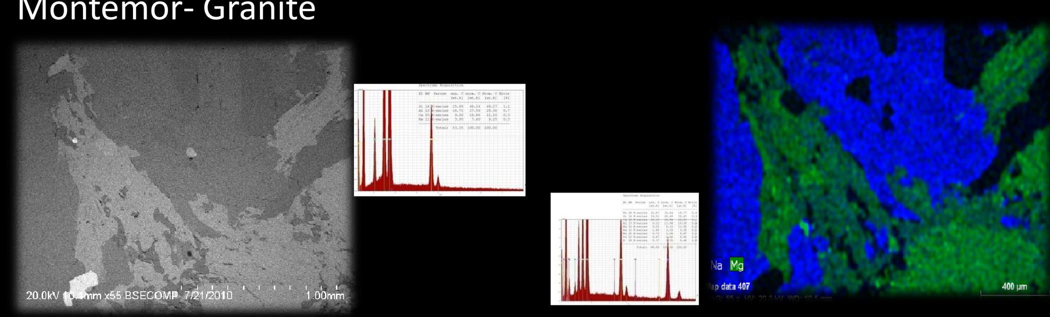
it is possible to differentiate calcite ($CaCO_3$) and dolomite ($CaMg(CO_3)_2$). The calcite have some Mg . It is possible identify two kinds of dolomites: one in large cristals and another in small grains in calcite.

Santa Eulália - Granite



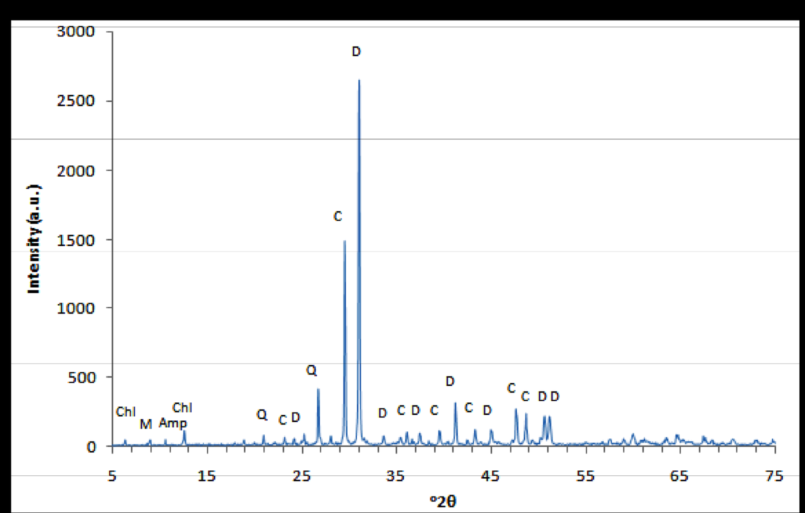
In this picture is possible to distinguish between various types of feldspar considering the contents of K, Na and Ca. These minerals are zoned with a Ca-rich core and outmost Na-rich area.

Montemor- Granite



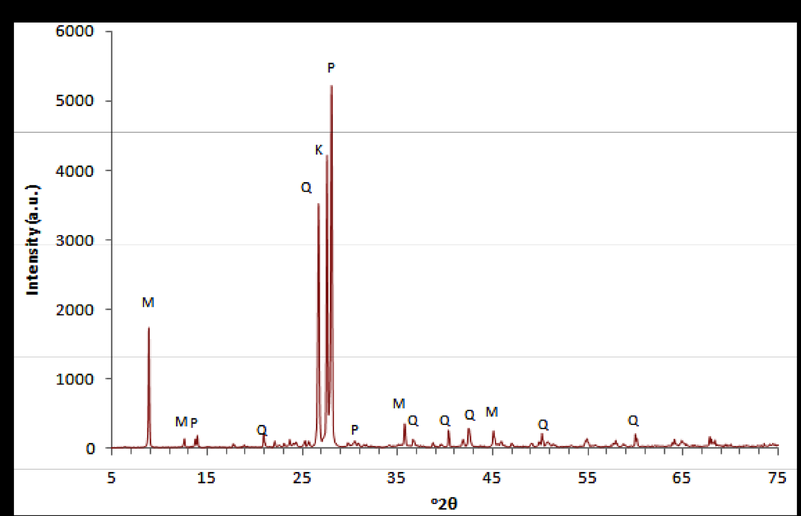
Plagioclase (rich in Na) and hornblende amphibole (richer in Mg) as example of the Montemor granitoid texture.

3.3 DRX



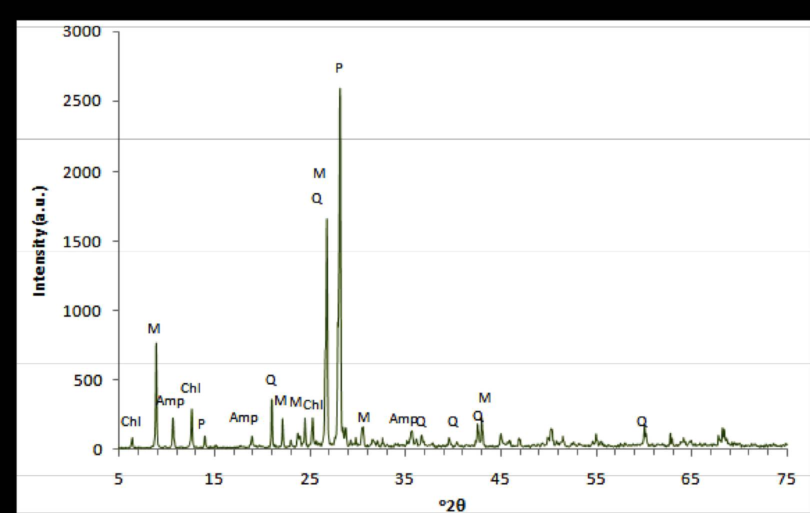
C - Calcite, D - Dolomite, Q - Quartz; Chl - chlorite; M - Muscovite; Amp - Amphibole

The Cano sample is macroscopically very heterogeneous mainly in what concerns to color. The XRD data show that the rock is composed essentially by dolomite and calcite with some quartz and minor contents of chlorite, amphibole and muscovite. Nevertheless, these minerals constrain the color of the rock, an important feature for the exploitation operations.



Q - Quartz; Chl - chlorite; M - Mica; P - Plagioclase; (Albite); K - K-feldspar

In this sample of Santa Eulália granite, predominate plagioclase (albite), quartz and also some amount of mica.

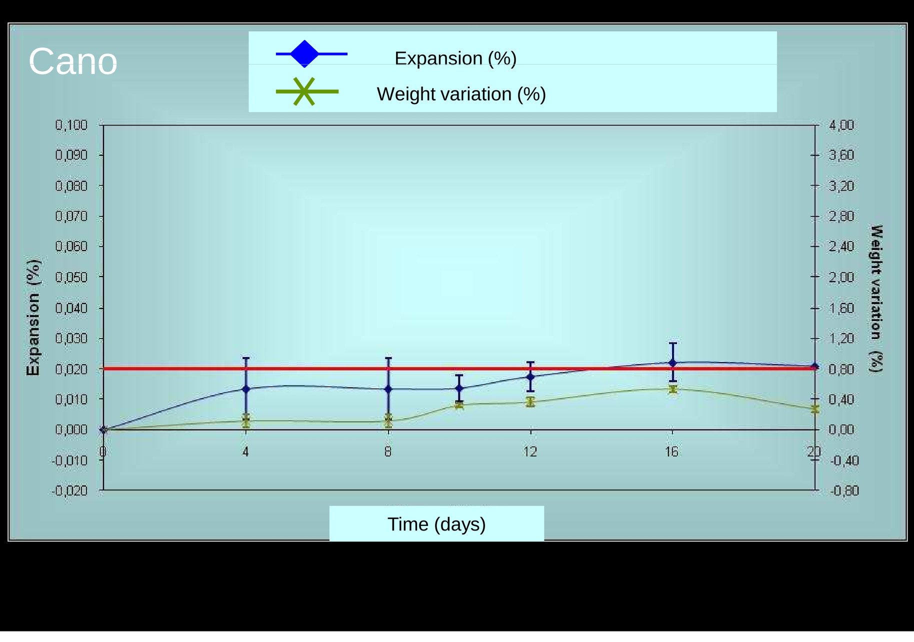


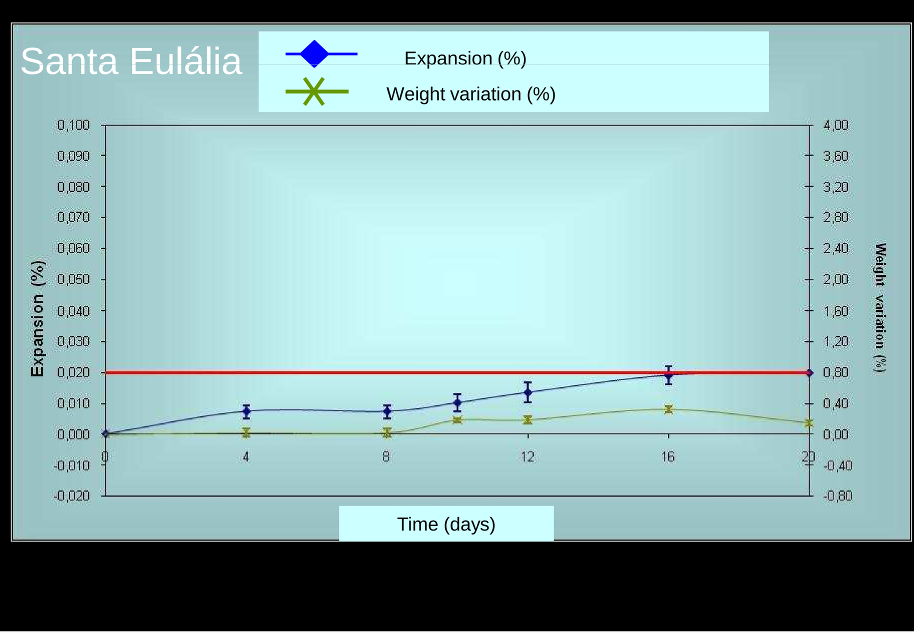
Q - Quartz; Chl - chlorite; M - Mica; P - Plagioclase; Amp - Amphibole

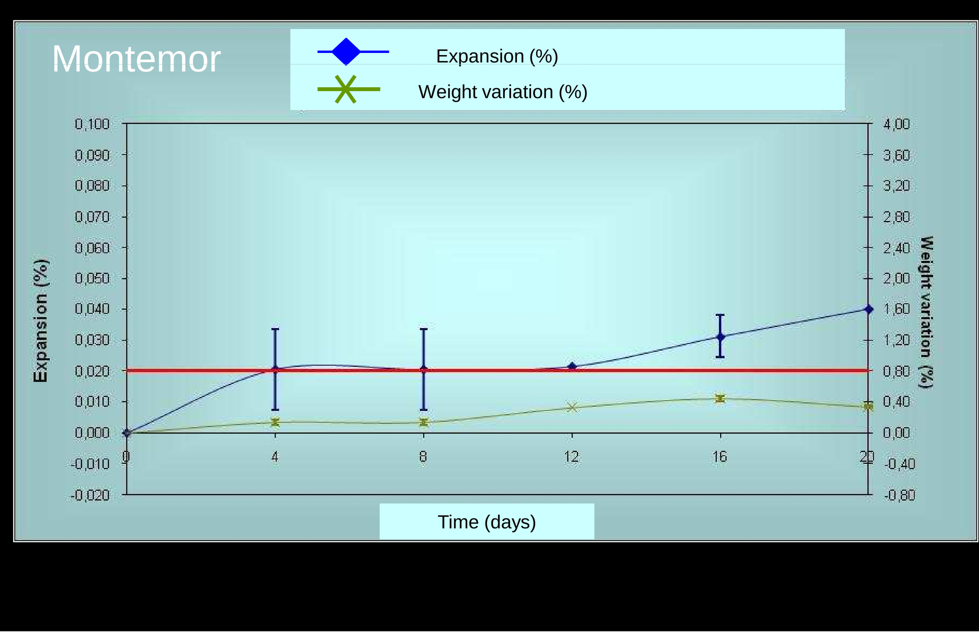
In Montemor granite predominate minerals such as plagioclase and quartz, the amount of mafic minerals is higher than the Santa Eulália massif noticing also the presence some of amphibole and chlorite

4. RILEM AAR-4

The detection of Alkali-Reactivity Potential of the aggregates in concrete was done by the Accelerated concrete prism method (RILEM AAR-4). After 3 months only the Montemor aggregates concrete show significant expansibility. The concretes with Cano and Santa Eulália aggregates are very close to the 0.02% expansion reference value.







5. Conclusions

The mineralogy of the three aggregates are quite different. In this preliminary work , a dolomitic (Cano) and two igneous rocks (Montemor and Santa Eulália) aggregates were described. The Cano is a combination of calcite and dolomite with some silicates. The Montemor rock is more rich in magnesium and iron minerals. The Santa Eulalia feldspars are undoubtedly more alkaline and the silica content is also higher.

Besides no explanation is provided , the Montemor aggregate seems to be more alkaline reactive. The study proceeds to explain this issue.

acknowledgements

The authors wish to acknowledge the Fundação para a Ciência e Tecnologia and FEDER for financial support under project EXREACT (Mitigation of deleterious internal EXpansive REACTions in concrete structures , PTDC/CTM/65243/2006)