Mechanical properties of anhydrites and dolomites in the framework of the seismogenesis of the Umbria-Marche Apennines (Central Italy)

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The Umbria-Marche Apennines are presently affected by normal faulting with a minumum principal stress sigma3 oriented NE-SW. The active normal faults strike about NW-SE and dip towards SW; the activity of some of these faults (the Norcia fault, the Gubbio fault, the Colfiorito fault system) is testified by the present day seismicity (Norcia, 1979 M = 5.9; Gubbio, 1984 M = 5.2; Colfiorito, 1997-98 M(MAX=5.9). The main shocks, characterised by extensional focal mechanisms, occurred in the same area where a well-documented historical seismicity is located (Imax=X).
By matching geophysical (reflection seismic) and geological data with detailed seismological data regarding the hypocentral locations, it has been argued that the seismic sequences depths are comparable with the depth of the base of the triassic evaporitic sequence (varying from about 6 to 9 km depth), hence suggesting the nucleation of many seismic events within this formation (e.g. Barchi 2002). Anhydrite and dolomite are two major components of the evaporitic sequence (Anidriti di Burano fm) within the Umbria-Marche Apennines stratigraphy. This formation is estimated to be up to about 2000m thick and is very widespread in this region as testified by data arising from deep-wells drilled in the past years .
Here we deal with the mechanical behaviour of the anhydrite by means of laboratory data and its frictional properties in the framework of the Umbria-Marche seismicity. Data seem to indicate that at low strain-rates the anhydrite deforms in a ductile manner and/or accommodates the deformation through many small ruptures; on the other hand, available data on dolomite and observations of deep-wells thin sections suggest that the dolomite is harder than the anhydrite and still brittle at the considered depths. Further work is needed to provide a mechanical framework in which to interpret data that suggest the occurrence of earthquakes within the evaporites and to understand the mechanical behaviour of the anhydrite as a mixture with other materials (i.e. dolomite) and as a fuction of pore pressure. Nevertheless, it can be argued that seismogenic ruptures within the dolomitic blocks may fault along discrete planes also across the anhydrite. This process would be favoured by high pore fluid pressures, the possible involment of which has been invoked as a possible triggering for this region (e.g. Collettini, 2001), which decrease the normal stress and promote localized faulting at depths where a ductile faulting would be expected. In this context, CO2 overpressures are likely to be present, as CO2 mantle degassing is widespread in this region and an overpressure of about 100MPa has been encountered in a deep weel drilled within the evaporitic sequence.

References

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