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Stiff clay masses: big storages of fossil and renewable energy

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The crystalline structure of the clay and its behaviour at the micro and macro scale have been and are still the object of studies in different fields of earth science: mineralogy, geotechnics, etc. It has been known for several decades that the volumetric equilibrium of a well-defined clay (mono mineralogical or mineralogical melange, with or without the mixing with other fines), depends on the salinity of the interstitial fluid (in terms of concentration of one or more kind of salts) under a stress field. The mechanism is very complex involving many chemical and physical topics, but may be easy to understand: the elementary structures of a two faced crystals are electrically negative charged with the interstitial fluid as the dielectric of a capacitor. Consequently, an electrical field is generated whose intensity depends on the electric charge and the properties of the dielectric. Such electric field can produce mechanical work, enlarging the faces of the capacitor, unless external forces prevent it. If external forces exceed the internal ones, the system behaves as a loaded spring, which stores energy of deformation to give back as soon as the external force weakens.
The clay of marine sedimentation incorporates interstitial salt water of composition derived and similar to those of sea water. Such type of interstitial water chemically has high concentration of dissolved ions, mainly Na, which generates in the dielectric spaces a low electrical field, compared with that given in identical situation by low salt concentration in interstitial water. In nature, as well described in geoscience, the turning between the two interstitial water types is very common and driven by ion diffusion processes like, surface fresh water interacting with salt interstitial water of old marine clays. The latter, either by the overburden of younger sedimentary layers, but mainly by very strong capillary forces activated by surface drainage and EVT from sun and dry wind, undergo strong volumetric reduction, which can be released with work production (well known as the swelling of the stiff clays).
The measurements of the released work by marine clays after ionic diffusion in fresh water has been extensively tested in oedometer apparatus (which allows one dimensional volumetric variation), and for Plio-Pleistocene blue clays of a wide South Italian region, gathering a mean specific energy in the order of 55 KJ / m3 of clay ($\sim$ 0,015 KWh/m3). Undoubtedly it is a poor specific quantity of energy released, but it may be interesting the enormous quantity of available clays and the circumstance that the clays washing with sea water and drying by the sun allows that the process can be always repeated, substantially storing sun energy, can be later released.