Which forces are responsible for holding highly porous chalks together? We use the effective stress to quantify the electrostatic effects around particle contacts originating from the adsorption of ions onto charged mineral surfaces. The induration of chalk indicates that it is held together by contact cement, where planar crystal contacts allow the action of short-ranged adhesive Van der Waals forces. At particle distances exceeding a few nanometers, recent studies have indicated electrostatic repulsion between water-embedded adjacent particles. The magnitude of the repelling force depends, among other parameters, upon temperature and brine composition. Our premise is that by perturbing the electrostatic forces at the particle level, we can control the mechanical behavior of chalk samples tested in triaxial cells. We report the results of an experimental series, investigating how the mechanical strength and stiffness varied among samples saturated with four different brines, tested at two temperatures, and tested directly or after aging for three weeks at high temperature. We associate stiffness with bulk modulus and strength with the stress at yield. Systematic softening and weakening is observed, especially when the pore fluid is sulfate bearing, as well as for some high-temperature experiments and for aged samples. However, softening and weakening are not totally correlated, and neither brine composition, temperature, nor aging can alone dictate the mechanical behavior of the chalk - a combination is required to predict the chalk stiffness and strength. To obtain a coherent description of our experimental results, we estimated the electrostatic stress arising from ion adsorption and found it unnecessary for these experiments to postulate significant dissolution or precipitation-related changes to the rock frame.