EVALUATION OF SHALE REACTIVITY

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The shale reactivity potential is normally associated to the reactivity potential of its mineral constituents. Shale samples from 4 different sedimentary basins were tested in order to investigate the relationship between the reactivity potential of the clay minerals present in the shales and the reactivity potential of the shales. Undisturbed, fresh shale samples, cut from well preserved core were exposed to fluids in order to study the effects of shale-fluid interaction. Simple immersion tests in saline solutions (NaCl and KCl) and in deionized water were conducted for periods up to one week. Laboratory failure tests indicated no influence of the type of fluid on the results of shale strength for two types of shales: low smectite type (Campos Basin, Brazil) and high smectite shale (North Sea, Norway). After these tests it was decided to prepare samples from the material that had been exposed to fluids and evaluate the eventual shale-fluid interaction by petrographic techniques. A full suite of tests was carried out in order to investigate this problem, including chemical analyses, X-ray difractometry, observations using petrographic microscope and SEM/EDS analyses. Chemical analyses and SEM/EDS images indicated that the shale from offshore Norway had a strong siliceous cement and the shale from Campos Basin was cemented by calcium carbonate. In spite of the fact that the sample from Norway had a high percentage of smectite (about 40%), SEM/EDS images were prepared from samples both before and after exposition with deonized water for over a week. The images of the Norwegian shale after exposition to deionized water indicating the presence of fossils, clay particles and pyrite and no modification of the original rock microstructure. The image of a clay particle in the structure of the offshore Brazil shale after exposition to deionized water indicating no appreciable fluid-rock interaction. In all the samples, the natural fluid content was preserved in order to simulate the actual field situation regarding fluid deficit. Our results indicate that the reactivity potential of shales is not a function only of the clay constituents but of the cementing agent and of the difference between the natural fluid content and the fluid content before the test. That is to say, the presence of smectite in a shale is not a sufficient condition for shale expansion or reactivity when in contact with drilling fluid. This conclusion has a significant impact in the practice of drilling fluid selection in the oil industry.