A new concept of Deep Rock Stress Tester (DRST) proposed for scientific deep drilling

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Hydraulic fracturing is suitable in principle for in-situ stress measurements at deep depths. However, as has been pointed out recently, its current testing systems and procedure involve essential problems which have to be solved before putting the principle into practice. The most serious problem is associated with the hydraulic compliance of fracturing systems. For measuring the reopening pressure, it is necessary to use the fracturing system with sufficiently small compliance. If not, there is no way to estimate the maximum horizontal stress from the reopening pressure assuming a vertical borehole, even though the maximum horizontal stress is the greatest concern in the stress measurement. This limitation makes it difficult to apply hydraulic fracturing for the stress measurement, because the compliance of the conventional system is so large. Taking into account of these facts, we have proposed recently a new method which will allow us to measure both of the maximum and minimum stresses by in-situ tests of hydraulic fracturing at a depth greater than a few km. We call this method the Baby Borehole Hydrofracturing or BABHY for short. In this method, it is assumed that the drill string containing a wireline retrievable core barrel assembly has been set in the borehole. There should be two assemblies which are (i) a wireline-retrievable coring system with a thin-kerf core bit driven by a mud motor, and (ii) a wireline tool containing straddle packers, an impression packer, two pumps used for fracturing and inflating packers respectively, two tanks of fluid for pumping, a compass for detecting tool orientation and a thermometer. The built-in pumps are not essential for reducing the system compliance but contribute to taking away troublesome long tubing which is necessary to convey fracturing fluid downhole when the pumps are placed on the surface. The assemblies (i) and (ii) are referred to as the mud motor coring system and the Deep Rock Stress Tester (DRST) respectively. We have proceeded to test and verify the concept step by step so far through field and laboratory experiments, and in 2007, we succeeded in applying it to an in-situ test at a depth of 811 m in a vertical borehole drilled from the ground surface.