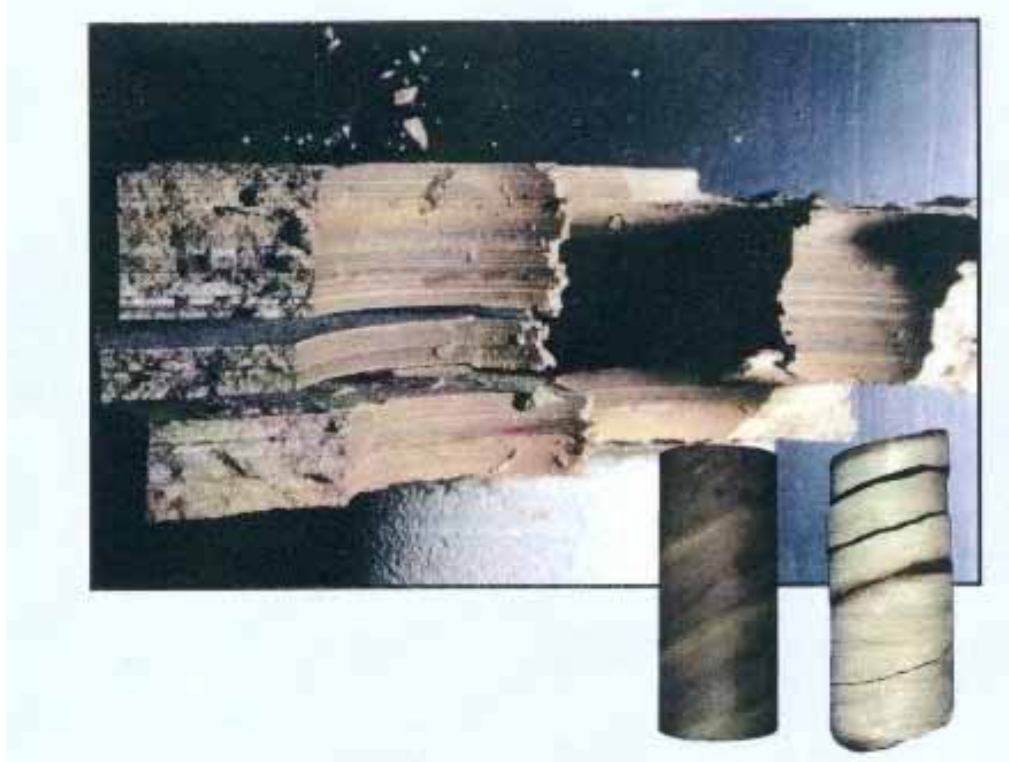


Stabilisation of Unconsolidated Reservoir Rocks for Core Analysis

Adam Moss, ResLab ART



As the exploitation of shallow hydrocarbon reservoirs becomes increasingly common, friable or unconsolidated core is often encountered. This unconsolidated core must be protected during drilling and when transported from the rig to a core analysis lab. Problems cutting and maintaining the integrity of plug samples from such material also need to be addressed.

Stabilisation of Reservoir Core

The earliest attempts at stabilising unconsolidated core material involved freezing to solidify the pore fluids. The success of core freezing depends on many factors including, freezing rate, saturation and brine salinity. There is evidence that freezing can induce fractures within the core and cause irreversible alteration of the core's petrophysical properties (Torsaeter and Beldring, 1985). The injection of a wax within the space between the core and liner barrel has been used as an alternative to freezing. Wax can often contaminate the core and has now been superseded by fast curing resins. Core stabilisation using resins has become common, but concerns have been raised over the applicability of resin stabilised core for wettability and geochemical tests (Hjelmeland *et. al.*, 1998).

A recent development involves core stabilisation by foam injection. Foam is found to cause minimal grain disturbance and does not induce fractures. Whilst successfully protecting the core material, the application of organic compounds to the core may alter the wettability of the grain surfaces.

Gypsum ($\text{CaSO}_4 \cdot 0.5 \text{H}_2\text{O}$) is a cheap, non-toxic, benign alternative to foam. Being an inorganic compound, gypsum avoids the potential geochemical alteration problems of the organic resins and foams. Retardation and curing agents have been developed to control viscosity and setting times. Tests have shown that invasion of the gypsum into the pore space is minimal, 1-2mm within a synthetic high permeability sandstone (Hjelmeland *et. al.*, 1998).

Plug Sampling in Unconsolidated Core

Most special core analysis programs involve cutting one or one and a half inch diameter plugs from the core. In unconsolidated rocks this can be difficult. A standard plugging drill bit with water lubrication will often destroy friable rocks providing at best irregular shaped plugs. Plugs can be cut in soft sediments using plunge cutters. This involves cutting the plug using a non-rotating cutting bit, similar to a pastry cutter, which is driven into the core. Plunge cutters have been developed that sleeve the plug in heatshrink sleeving as it is cut in order to protect the sample for further analysis. Special drill bits have been developed for cutting plugs from harder rocks, which plunge cutters, can not sample. These involve the use of compressed air to clean the drill bit and spiral channels on the outer face of the bit to remove waste material that could clog the bit and damage the plug sample. Heatshrink protective sleeves can also be applied as the plug is cut.

Research is being conducted at ResLab ART to find compounds that can stabilise unconsolidated rocks and allow plug sampling without special equipment. Various organic compounds are available which are liquids at room conditions and solidify at slightly lower temperatures. Such compounds are left to imbibe into the pore space of a core piece, the sample is then chilled in a fridge. The resulting core material is strong enough to withstand plugging by a standard drill bit and subsequent protection in heatshrink sleeving. Whilst not requiring any investment in specialist equipment, plugs cut in this way could not be used for geochemical/wettability testing.

The methods selected to stabilise unconsolidated reservoir core material depend on the proposed core analysis programs. Techniques have been developed to protect friable rocks during all stages of sample preparation which with careful selection and application can help supply quality material which in turn helps provide accurate core analysis data.

References

Hjelmeland O., Tjetland B.G., Ardo B.A., Bolle L., Scheie A. and Venturini C., "A new method for stabilization of friable and unconsolidated core samples at well-site", Petroleum Science and Engineering, 1998, Vol. 19, pp 7-19.

Torsaeter O. and Beldring B., "The effects of freezing of slightly unconsolidated cores" SPE Paper 14300, 60th Annual Technical Conference of the SPE, 22-25th September 1985.