Collection and measurements of reservoir fluids properties – 'Today and tomorrow'

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Representative analyses of properties of hydrocarbon and non-hydrocarbon fluids in the petroleum industry strictly depend on the quality of the sub- or surface sampling. The exploration & appraisal activities in challenging pressure and temperature environments, as well as difficult fluids such as heavy oils, very high levels of H_2S or CO_2 require a completely new approach. Development and implementation of new technologies is a must, not a luxury.

Experience shows that the majority of non-representative data coming from laboratories are directly due to poor sampling practices and/or inadequate technologies employed. Recent improvements in sampling tools, include innovative approaches to prevent scavenging of H_2S, or absorption of mercury species, utilizing exotic metarials such as Inconel 725, and inert coatings such as Dursan. The increased working range of sampling/analytical equipment is reaching pressures of 1700 bar (25 kpsi) and temperatures of 200°C.

Recent years have also witnessed increased focus on *in situ* measurements at downhole conditions, or as close to the wellsite as possible. Evolution of optical absorption spectroscopic tools such as LFA (Live Fluid Analyzer) led to developemnts of 'downhole laboratories' employing Grating Spectrometer technology, such as IFA (InSitu Fluid Analyzer) providing critical data on fluid properties (C_1, C_2, $C_{3\text{-}5}$, C_{6+}, CO_2, Gas-Oil Ratio, density, viscosity) in real time. The live water pH is now possible, both in the reservoir as well as in the laboratory. Breakthroughs in the mud gas logging are included an unprecedented leap from qualitative/comodity tools to quantiative fluid facies evalaution while drilling in $C_{1\text{-}6}$ range, including application of GC/MS and laser MS technologies for the methane stable isotope measurements.

The need for *in situ* measurements requires miniaturization and operational robustness. This article will discuss the latest advances in sampling and measurements along the fluid value chain – from the reservoir to laboratory.

Cadomian igneous rocks from Europe's Variscan belt, Lazovo complex

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The geochemical and the age information contained in the Cadomian/Pan-African orogeny elements in Europe helps to identify portions of the Neoproterozoic-Cambrian plate boundaries [1]. In the Balkanides several types of such elements are known: some of the protolithes of Srednogorie high-grade metamorphic series - intermediate and acid igneous rocks ~590-620 Ma old [2]; Cherni Vrah ophiolite complex - ~560 Ma [3]; and 550 to 1100 Ma old inherited zircon cores detected in all high-grade metamorphic rocks.

We studied one of the easternmost exposures of the Variscan belt in the Balkanides in Tvarditsa mountain. The metamorphites of Lazovo complex cover wide areas of its southern slopes and host the pre-Triassic Tvarditsa pluton [4]. GPA geothermobarometry shows that amphibolite facies conditions were reached [5] in Variscan times [6].

The metamorphites in the eastern parts of Lazovo complex formed over intermediate to basic igneous protholites containing lense- and layer-shaped bodies of pyroxenites. They had different pre-Varsican metamorphic history compared to the garnet-bearing and the two-mica gneisses in the western parts of the complex [5]. The eastern part gneisses studied form thick layers of distictive composition, not related to metamorphic differentiation. They preserve field and geochemical evidence of their magmatic origin. Their trace-element composition suggests subduction-oriented source.

The zircons from the gneisses sudied and from the metapyroxenites have slightly elongated to rounded shapes. They display growth and sector zoning corresponding to igneous conditions of crystallisation. The U-Pb ages of the zircons obtained by LA-ICP-MS cluster at around 600 Ma.

Our data constrain for the first time the protholith age of Lazovo complex metamorphites and allow better correlation with the Neoproterozoic terrains in Eastern Europe.

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