



## Subsurface detectives

DNO's team of subsurface detectives, equipped with hammers and smart phones, explore the earth for clues that can reveal where to drill for oil and gas.

The detective work starts out in the field in search of clues for the best reservoirs, underground rock formations where oil and gas have accumulated. Geologists read the lines and folds of the mountains or look for places where oil seeps out and runs down the hillsides like little black streams. They may even use their noses to see if a rock has an oily smell – or rely on their intuition.

These detectives, who look like something out of new Indiana Jones movie, take soil and rock samples for hints as to what lies below the earth's surface. They are not only exploring space but also time, unraveling layer-by-layer the earth's history. A rock can tell a story that may be a billion years old. During the course of millions of years, rocks containing organic matter have been compressed by huge movements in the earth's crust to form oil and gas.

When DNO entered the Kurdistan region of Iraq in 2004 as the first international oil company in the region since the late 1950s, Kurdistan was virtually unexplored. This gave DNO a head start.

### **Geologist's dream**

It was a geologist's dream come true. Kurdistan contains one of the richest oil and gas structures in the world.

The Zagros mountains that spread over Kurdistan – where DNO has its biggest producing fields, Tawke and Peshkibir – are home to some of the largest undeveloped hydrocarbon reservoirs in the world.

These mountains are part of the Alpine-Himalayan mountain chain that stretches across much of Southwest Asia and the Middle East. The Zagros mountains were formed after the Arabian and Eurasian plates collided during the late Cretaceous period some 70 million years ago, and contain many anticlines – arch-shaped folds in the rocks that form many excellent hydrocarbon traps. This is what the geologists want to find.

The reservoir rocks, which in Kurdistan consist mostly of fractured carbonates, were created by the shellfish, corals, clams and microorganisms that once lived in a large sea known as the Tethys Sea. When the two plates collided, this ocean disappeared and the ocean floor buckled under, trapping the rich sea life.

Geologists want to find the shallow borders of the lost Tethys Sea, where the best hydrocarbon reservoirs can be found. In addition to their traditional tools, such as hammers and notebooks, geologists also use their iPhones as digital compasses or to take measurements and record data.

### **Reconstructing the past**

Back at the office, they try to reconstruct an area as it may have evolved over millions of years with the help of advanced technology. They draw maps of long-lost rivers, lakes, shorelines and mountains and of how these have moved and changed. At a later stage, seismic data is a crucial tool to assist in mapping reservoirs and to help decide where to start drilling.

The subsurface teams act like knowledge hubs with everyone working closely together to achieve a seamless, interdisciplinary transfer of information.

DNO has built up its expertise as fractured carbonate specialists in the Middle East and North Africa. Oil finds are based on geological understanding, which is why DNO has focused on making geology one of its core fields of competence.

By getting a head start as pioneers in Kurdistan, DNO managed to gather data of the subsurface there ahead of other oil companies that are now investing in the same region. This is one of the reasons for DNO's success in Kurdistan. It was the right company at the right spot and the right time.