

## 06

### **Geo-electrical Monitoring of Oil (and Gas) reservoirs**

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Because of the large resistivity contrast between oil and brine, monitoring the oil-water contact during production is a potentially interesting technique. However, it is not used in practice today. We believe that this subject has possibilities and deserves more attention. Applying geo-electrical monitoring of oil reservoirs may e.g. possibly identify “bypassed areas”. The technique can be significantly cheaper than 4D seismic, especially on-land. At TNO we modeled (3D) different borehole-to-surface electrode configurations for monitoring the lateral position of the oil-water contact and inventoried e.g. their sensitivity versus depth of the reservoir. For this we looked at a rectangular reservoir, but also at a “realistic” reservoir with varying porosity and oil saturations derived from reservoir modeling. Results are looked at in terms of the difference between the potential fields (more than using apparent resistivities) at different time steps. In the modeling we see something we call “the dipole of monitoring”, a concept that can help to design effective electrode configurations for a specific hydrocarbon field. Results indicate that for a configuration applying an electrode above and below the reservoir in combination with surface electrodes, the sensitivity is not so depth dependent, whereas for a single-borehole to surface configuration the sensitivity decreases quickly with depth. Also results from some laboratory experiments that were conducted to test a specific configuration are shown. For this a pvc-tank of (75 cm \* 55 cm) was filled with sand and electrodes (both buried and surface) were placed. The oil water contact was simulated using a very thin plastic plate whose position could be moved. The tank results encourage the further development of the geo-electrical monitoring technique.