TITLE: **Seismic expression of hydrocarbon accumulations and seeps.**

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In the 1970's explorationists realized that under favorable conditions hydrocarbon effects could be seen on seismic data. Ever since Direct Hydrocarbon Indicators (DHIs) such as flat-spots, bright-spots and polarity reversals are mapped routinely. Over the years the technology has advanced from pure qualitative to quantitative. In modern quantitative seismic interpretation studies it is common to predict from seismic measurements relevant reservoir properties such as porosity, fluid-type and lithology.

That hydrocarbon seeps also have an impact on the seismic response has been known for many years as well. Direct evidence of seepage is a so-called chimney, a vertical disturbance of the seismic response. These are caused by saturated fluids and/or free gas migrating through porous rocks. As the fluids move up the pressure drops and solution gas is released. Some gas stays in the pores, thus changing the acoustic properties of the rock. This connate gas affects especially the P-wave velocity. Alternatively, over-pressured fluids may have cracked the rocks causing scattering of the seismic waves. Until recently these disturbances were considered unwanted noise that obscured the reflection energy.

However, research a/o by scientists from Statoil revealed that chimneys contain a wealth of information and are worth studying. Chimney interpretation helps to unravel a basin's hydrocarbon history, distinguish between charged and non-charged prospects, between leaking and sealing faults, and to detect geo-hazards. In the early days of chimney interpretation, the main problem was that the exact outline of a chimney is very difficult to determine on conventional seismic displays. Only large chimneys can be recognized. To also detect more subtle disturbances the data is transformed into a new cube that highlights vertical disturbances. A supervised neural network does this. The network is trained on example locations that are chosen inside interpreted chimneys as well as outside. Multiple attributes are extracted in vertically aligned windows at these example locations. The trained network is subsequently applied to the entire seismic cube on a trace-by-trace and sample-by-sample basis. A high output value indicates a high chimney probability at each location.

The chimney cube has been used successfully for exploration tasks and for geo-hazard interpretation in many areas around the world. So far, the technique is still qualitative in nature and can be compared to the state of DHI mapping in the 1970's.

In this paper I will introduce the chimney cube method, show examples and sketch the future. An integrated research effort involving seismic interpreters, geo-chemists and remote sensing specialists will be required to use this technology quantitatively to predict hydrocarbon emissions.