



## Outcrop-based reservoir geology – Utah (United States) Intermediate level

Course format: field seminar

Trainer: Dr. W.J.E. van de Graaff

Evert van de Graaff was awarded his Ph.D. in sedimentary geology by Leiden University in 1971. He worked as a field geologist on sedimentary basin studies in Australia till 1978. After joining Shell in 1978 he held operational assignments as reservoir geologist / production geologist / petroleum engineering team leader with Brunei Shell Petroleum, Shell Expro and the NAM (Shell's Dutch operating company). Whilst based in Shell's headquarters in The Hague he worked on a wide range of reservoir characterisation / modelling projects covering both clastic and carbonate reservoirs in many parts of the world (North Sea, South America, Africa, Middle East, Far East, Australasia). Following a 5-year stint as senior lecturer in Geosciences at Shell's EP training department he was senior technical advisor /team leader for static reservoir modelling technology. In this capacity he also carried out numerous QC reviews on the subsurface aspects (including reserves estimates) of field development plans and A & D opportunities. After retiring from Shell in 2003 he started his own consultancy in parallel with working ad hoc for PanTerra.

### Business Context

Modern reservoir modelling software provides EP professionals with the ability to quickly build detailed 3D static models of subsurface reservoirs. The speed with which these models can be built and the detail that they show was difficult to imagine even a few years ago. Though on a computer screen these models look very convincing it is easy to forget that these models are based on many implicit and explicit assumptions about the nature of the subsurface reservoir. These assumptions should be geologically realistic if the model is to be of any value for EP decision making. Both the modeller and the user of the reservoir models must have a good understanding of reservoir geological concepts in combination with the principles of hydrocarbon recovery mechanisms, if the reservoir models are to deliver maximum value to the EP business.

### Course content

- Deltaic clastics
- Desert clastics
- Lacustrine clastics
- Platform carbonates
  - Sequence stratigraphy of these depositional systems
- Salt tectonics

- Fault sealing and reservoir compartmentalisation
- Subsurface stress systems
  - Impact on well planning

This field course covers a variety of reservoir analogues, and will provide participants with a good understanding of what features of a reservoir should be captured in a static reservoir model and most importantly, why. Outcrop analogues include Tertiary lacustrine systems (Green River Formation), Cretaceous deltaics (Mesa Verde Group), Permian to Jurassic desert deposits (Wingate, Navajo & Entrada Formations), Carboniferous platform carbonates (Paradox Basin), and salt diapirs and associated fault systems.

NB This field course has a modular design and depending on the learning needs of the participants course modules may be included or dropped. The 5-day version covers deltaic and desert systems + salt-induced faulting. The 11-day version includes all modules.

#### Learning objectives

The course is outcrop based and many of the outcrops to be visited are kilometre-sized. These large-scale outcrops allow participants to view geological features at the scale of real oil and gas fields. This is extremely valuable as it helps participants to think through modelling issues from different perspectives.

At each outcrop the course participants are presented with a structured set of questions that conceptually guides them through the process of gathering reservoir data, interpreting the various data sources, and identifying key uncertainties in the data set. Last but not least they will predict how reservoir heterogeneity is likely to impact on different recovery mechanisms. In combination this helps the modeller to identify the parameters that should be incorporated in the static reservoir model, as well as to identify the key uncertainties in those models.

#### Duration & location

5, 9 or 11 days [duration depends on modules included]. The course begins and ends in Grand Junction (Colorado). Grand Junction is served by regular flights from Denver and Salt Lake City. Local transport will be by self-drive rental cars. Accommodation will be in good quality hotels.