IAEG Commission 16 - UNESCO World Heritage

Germany

PIT MESSEL

World Cultural Heritage since 1995

Engineering geological conditions and problems:

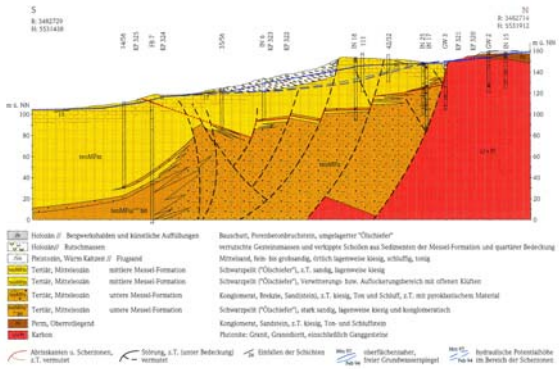
The oil shale deposits of the Messel pit have become famous through the discovery of superbly preserved vertebrate fossils of Eocene age. From 1885 to 1971 the oil shale of the Middle Messel Formation was excavated by open-cast mining and crude oil was extracted in an associated plant until 1961. The sediments of the Eocene Messel Formation accumulated inside a maar lake, separated from the surrounding Palaeozoic hard rocks (Lower Paleozoic diorite, granophyres and granodiorites as well as Permian sedimentary rocks) by marginal faults, of the collapsed diatreme. The deposits are subdivided into:

- Lower Messel Formation (secondary sediments with extraclasts),
- Middle Messel Formation (mostly straticulate oil shales),
- Upper Messel Formation (clay, silt, sand with brown coal).

Already during the active opencast mining landslides occurred with damages to person and material. Different mechanisms and forms of movement are documented in the whole pit area:

1. extensive active respectively latent or blocked landslides within Tertiary sediments with gliding, combined rotational and translational sliding failure of the embankments on existing divisional planes,
2. active respectively latent or blocked landslides limited to magmatic hard rocks and Rotliegend sedimentary rocks of the southeastern and eastern edges of the work zone with progressive gliding, combined rotational and translational sliding failure on divisional planes,
3. movements of man-made fillings within and beyond the pit area which are due to movements of the underlying Tertiary sediments or historic slide masses.
4. creeping movements of historical slide masses mentioned under 1. and 2.

Pit Messel - aerial view



Cross section through slide masses in the north-slope of the pit (NIX 2003)

Protection measures already have been taken or have to be taken:

On account of the instability of the embankments and in view of it's status as a UNESCO world heritage site the long term security of the pit embankments is of special importance. Hence, supervision and controlling measurements have been carried out since 1993 using the observation method (Eurocode 7) to be able to initiate early constructional measures for the protection of threatened embankment areas if necessary.

Up to now eleven horizontal drainage drillings with inclinations of - 10 ° or - 20 ° were made at the northern edge of the pit to reduce the joint water pressure in the adjoining Paleozoic hard rocks.

Other information:

In 1995 Pit Messel was included into the list of the UNESCO world heritage as the first German physical monument.

References on studies already performed:

ADERHOLD, G. & NIX, T. (1999): Geotechnisches Monitoring-Programm des Weltnaturerbes Grube Messel. - Schr.-Reihe Deutsch. Geol. Ges., **7:** 18; Hannover.

BACKHAUS, E. & RAHNAMA-RAD, J. (1991): Die Rutschungsgefährdung der Messel-Formation (Fundstätte Messel; Mittel-Eozän). Einflüsse der Tektonik, der Hydrogeologie und der Materialeigenschaften der Gesteine. - Cour. Forsch.-Inst. Senckenberg, **139:** 1-69; Frankfurt a. M.

HARMS, F.-J., NIX, T. & FELDER, M. (2003): Neue Darstellungen zur Geologie des Ölschiefer-Vorkommens Grube Messel. - Natur u. Museum, **133** (5): 140-148; Frankfurt a. M.

NIX, T. (2003): Untersuchung der ingenieurgeologischen Verhältnisse der Grube Messel (Darmstadt) im Hinblick auf die Langzeitstabilität der Grubenböschungen. - Unveröff. Diss. Techn. Univ. Darmstadt: 122 S.; Darmstadt.