FUGRO
MIP-CPT CONE

The MIP-CPT (Membrane Interface Probe) is used for in situ screening of CHC (Chlorinated Hydrocarbons) and other VOC (Volatile Organic Compounds) in the saturated and vadose zone.

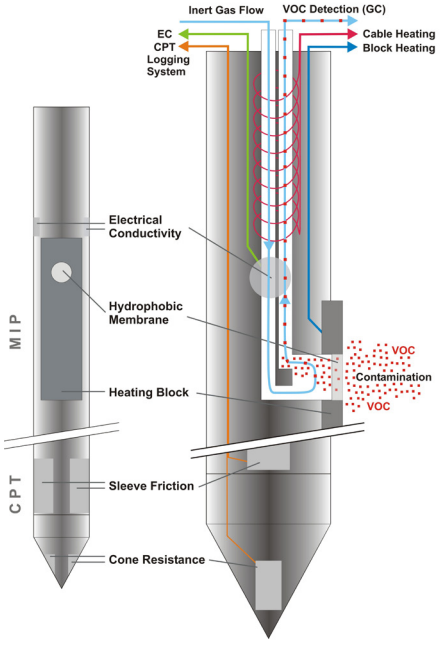
SCOPE OF APPLICATION

Risk assessments and remedial desk studies require detailed knowledge of the subsurface structure, as well as the contaminant geometry and spread in both source and plume areas. In situ investigation techniques are therefore essential for the vertical and horizontal delineation and characterisation of contaminated sites.

CPT CONE

Cone Penetration Testing (CPT) is a world-renowned method of conducting geotechnical investigations to determine soil and groundwater characteristics in situ. Fugro has developed a variety of penetrometers, probes and samplers that are hydraulically pushed into the subsurface soil to obtain physical and chemical data. Lightweight, detachable CPT units are ideal for difficult-to-access sites, whilst large trucks and all-terrain vehicles - with weights in the range of 15 to 30 tonnes - provide penetration reaction. The CPT cone can also be used to collect environmental data. With the interpretation of tip resistance and friction ratio, CPT data provide detailed lithological information of the subsurface soil.

There are several optional sensors that connect to the CPT cone and measure the vast majority of organic contaminants in the subsurface.



MIP-CPT layout.

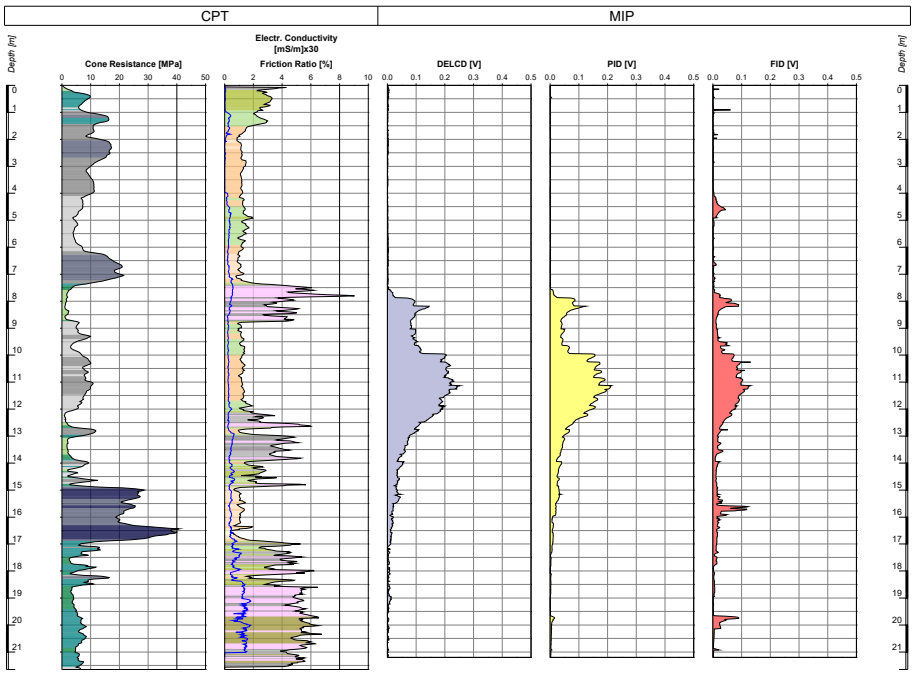
MIP CONE

The MIP cone can detect several VOCs, including PCE (tetrachloroethene), TCE (trichloroethene), and their biodegradation daughter products; together with BTEX, MTBE and other volatile hydrocarbons. A heated membrane on the cone's sleeve causes the compounds to be thermodesorbed and diffused across the membrane. They are then transported by a carrier gas stream through capillaries in the MIP cable up to the lab unit in the vehicle. Here, they are detected with a gas chromatograph, equipped with a PID (Photo Ionisation Detector), FID (Flame Ionisation Detector) and a DELCD (Dry Electrolytic Conductivity Detector). This detector combination allows for selective specification of the contaminant type.

Equipped with a 10.6 eV UV lamp, the PID responds to unsaturated chemical compounds such as chloroethenes or monoaromatic hydrocarbons with a lower ionisation potential compared to the excitation energy. The FID detects organic carbon, while the DELCD is able to detect organic bonded chlorine.

Fugro's MIP units are equipped with a unique heated cable to increase sensitivity and reduce detector tailing effects caused by VOC condensation or retardation in the capillaries. In addition to the CPT and MIP data, simultaneous electrical conductivity measurements are being performed. This enables the following data to be acquired in one push:

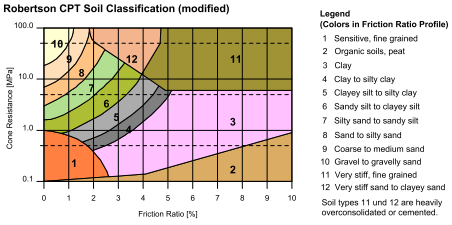
- Cone resistance
- Sleeve friction
- Friction ratio
- Electrical conductivity
- Porewater pressure
- DELCD, PID and FID logs



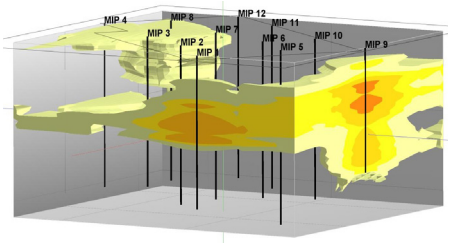
Resulting logs of a MIP-CPT investigation.

DETECTION LIMITS

MIP sensitivity to different compounds strongly depends on the detector/ membrane conditions, the length of the cable and the membrane temperature, but also on the vapour pressure and other physical/chemical properties of the relevant compound. Average detection limits can be given for PCE (300 ppb), TCE (200 ppb), DCE (400 ppb), VC (500 ppb), benzene (400 ppb), toluene (300 ppb) and xylenes (200 ppb) in groundwater. It should be noted that these are orders of magnitude that may vary according to site conditions.



Soil classification (after Robertson et. al, 1986)



3D presentation of the results of an MIP investigation.

Substance	PID	FID	DELCD
PCE	+++	+	+++
TCE	+++	+	+++
cDCE	++	+	++
tDCE	++	+	++
VC	+	+	+
TCA	-	+	+++
Benzol	+++	++	-
Toluol	+++	++	-
Ethylbenzol	+++	++	-
Xylole	+++	++	-

Sensitivity: +++ = high, ++ = medium, + = low, - = none

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