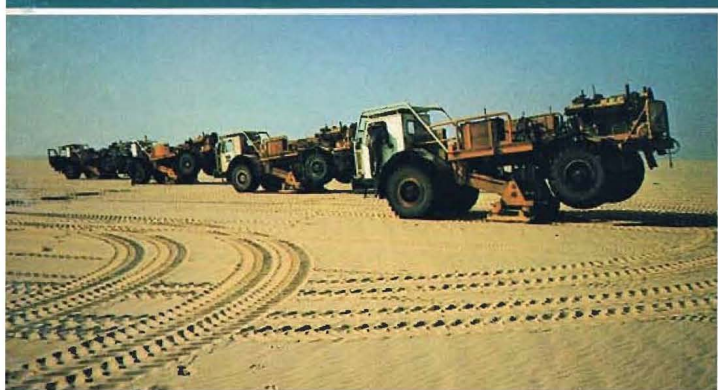
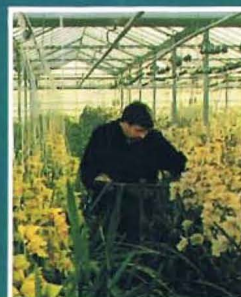




**Explosive Energy Source:**  
drilling and implantation techniques



**Non - Explosive  
Energy Sources**

*Vibrators*



*Hydraulic Hammer*



**Recording Systems  
and Accessories**







## Onshore Seismics Energy Sources and Recording Systems

### Introduction

Emitting and receiving/recording are the elementary procedures in seismic field operations.

This brochure gives an insight into our standard instrumentation in receiving and recording; its main topic, however, is to demonstrate the arsenal of vibrators and, in particular, of drilling rigs and tools used by our landseismic crews under the vastly different conditions encountered during their operations all over the world.

Whereas most of the instruments and tools for receiving and recording are purchased from specialists in seismic instrumentation, e.g. Texas Instruments, Sercel, etc., **on the emitter side**

developments, construction, and maintenance of both, drilling rigs and vibrators, are generally done by PRAKLA-SEISMOS Geomechanik, our subsidiary at Uetze (near Hannover), Germany.

### Contents

#### Explosive Energy Source: drilling and implantation techniques

Drilling Equipment

...the truck-mounted systems

Drilling Equipment

...the portable systems

Surface and Near-Surface Shooting

#### Non-Explosive Energy Sources

Standard Vibrators

New Vibrators, Final Stage of Development

Other Sources

#### Recording Systems and Accessories

Impulse-Seismic Recording Systems

VIBROSEIS® Recording Systems

Auxiliary Equipment

Receivers

Equipment Installation and Transport

#### *Construction of heavy drilling rigs by PRAKLA-SEISMOS Geomechanik*







***PRAKLA-SEISMOS Geomechanik Plant at Uetze  
(near Hannover), Germany***

## Explosive Energy Source: drilling and implantation techniques

In the following only the standard drilling equipment is presented.

### Drilling Equipment ...the truck-mounted systems

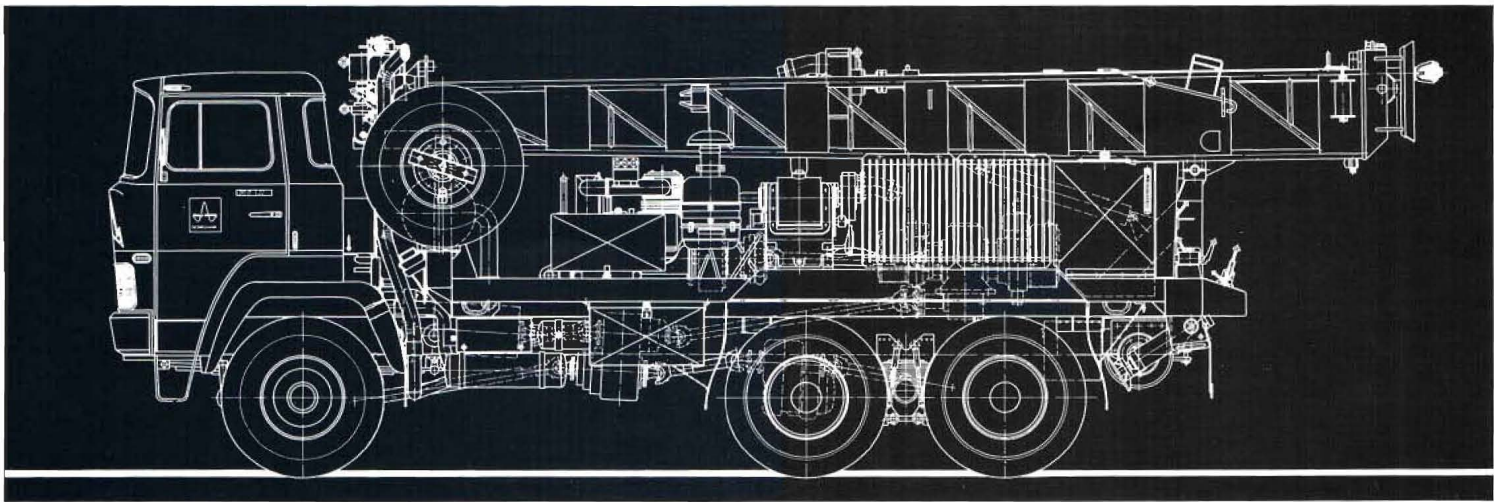


***Heavy rig, type P 5001***

The standard rig types:

Category	Type	Main Power Unit	Weight (kg)	Axles	max. Depth	Flushing Systems	Pumps
Heavy Rig	P 5001	235 kW (320 HP)	18 650	3	500 m	water, air or water/air	Piston (duplex power)
Medium Weight Rigs	P 3034	129 kW (179 HP)	14 200	2	300 m		
	P 3002	141 kW (192 HP)	11 500	2	300 m		
Light Rigs	P 1002	66 kW ( 90 HP)	6 050	2	120 m	water	9.5 m <sup>3</sup> /min 7.5 bar
	P 0101	96 kW (130 HP)	6 730	2	10 m	air	





*Side view of rig type P 5001*



*Heavy drilling rig and watertruck*



△

*Medium weight drilling rig,  
type P 3034*

*Four P 3034 drilling rigs  
with Unimog watertrucks*

◁







*Medium weight drilling rig, type P 3002*

▷  
The P 1002 rig is  
an extremely ver-  
satile light drilling  
rig, shown here in  
full action  
▽



*"Puffer unit", type 0101 in the  
Sahara, a hole-blowing device  
with high-pressure air  
(9.5 m<sup>3</sup>/min, 7.5 bar); no rotation  
involved!*



## Drilling Equipment ... the portable systems

Environmental demands and regulations led us to create suitable devices for small-diameter, shallow-hole, and small-charge lancing techniques: hand lancing, compressed-air or water-lancing, and pneumatic percussion hammers.

Specific advantages:

- real portability
- minimum field damage
- high productivity
- high resolution due to the small charges



*Hand lances.  
Arsenal of a  
seismic crew in  
the Netherlands*



### Compressed-air lance

for slim holes down to about 6 m.

The heart of the standard equipment is the flushing lance, each section being 2.5 m long and 35 mm in diameter. A 3.5 m<sup>3</sup>/min compressor is sufficient to operate a single lance.

For simultaneous operations of two or more lances a larger compressor (e.g. 9.5 m<sup>3</sup>/min) is advisable.

*A compressed-air  
lance in action*

### Flushing equipment T 20-ALU

The standard equipment has 7 aluminium tubes with a diameter of 45 mm, a length of 3 m, and a weight of 3 kg each.



*Flushing  
equipment  
T 20-ALU*





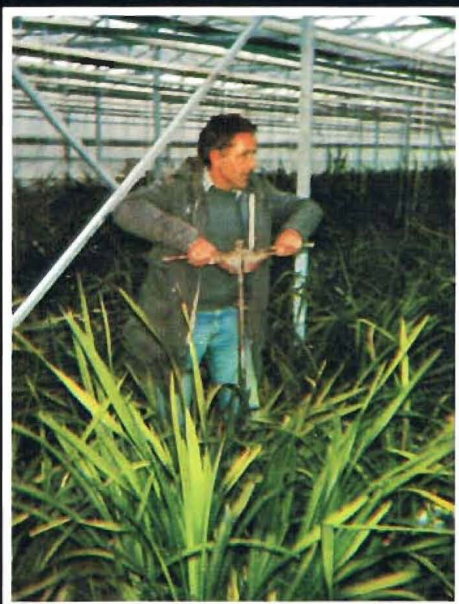
*Cable*



*Layout*

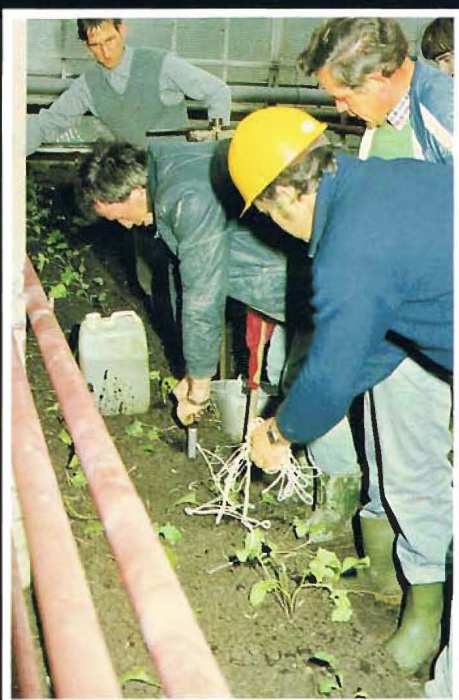


*Telemetry station  
(disinfected!)*

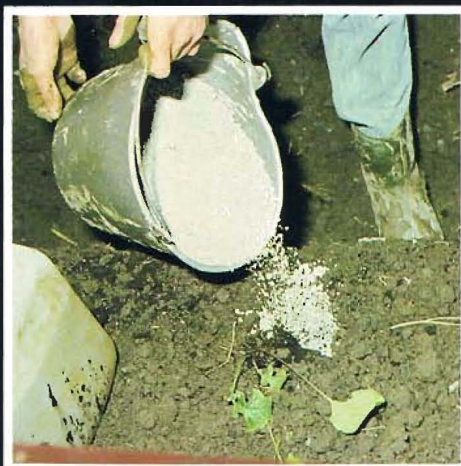


*Hand lance  
between flowers*

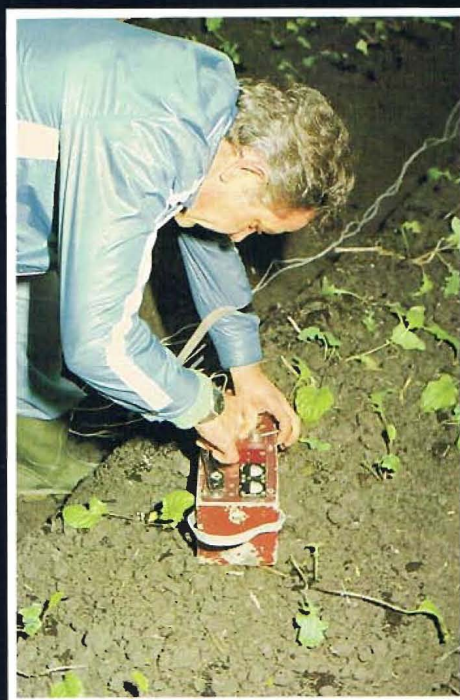
**3-D seismic lines crossing Holland's greenhouses.  
Shotholes are prepared with lances.**



*Charging (30 g)*



*Tamping*



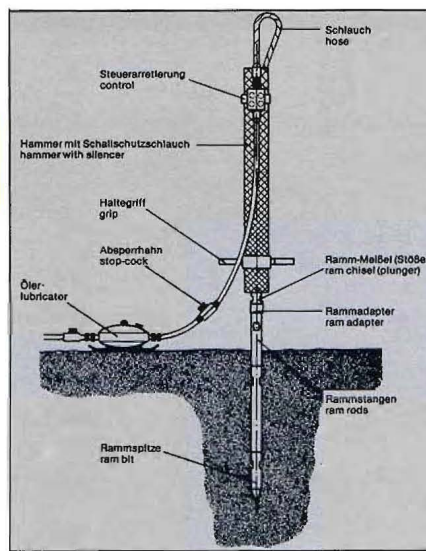
*Shooting*



## Pneumatic Ram Hammer RH 65 (TRACTO-TECHNIK)

The basic data of the system:

Weight: 25 kg  
Length: 1.20 m  
Impact rate: 450 /min  
Air consumption for  
max. pressure of 7 bar: 0.8 m<sup>3</sup>/min



***Ram Hammer RH 65,  
handled by two helpers***



Penetration rate in light to medium soil is 1 to 2 m per minute. Two skilled helpers can sink 20 to 30 holes, up to 4 m deep, within an hour.

The standard equipment consists of five ram rods, each 1 m long and 35 mm in diameter. The total weight is 136 kg (excluding the compressor).

Relatively low air consumption facilitates the running of two ram hammers simultaneously from a single 3.5 m<sup>3</sup>/min compressor.

## Surface and Near-Surface Shooting

This method is still applied in desert-like areas where drilling is not applicable due to bad access or other problems. Detonating cord is either ploughed into the top soil or laid on the surface, sometimes reinforced by dynamite charges.

***Airshot in the desert***

***Ploughing-in detonating cord***

***Mules carrying  
reels of detona-  
ting cord in  
rough moun-  
tains***





## Non-Explosive Energy Sources

**Standard Vibrators** (the frequency range specifications refer to the -3 dB point)



*Six VVCA crab vibrators in action*



### VVCA crab vibrator

Total Weight:	14 400 kg
Peak Force:	84.5 kN
Frequency Range:	6 to 105 Hz
Engine Power:	
– V8 Diesel:	142 kW at 2150 rpm
– V6 Diesel:	107 kW at 2150 rpm

The vibrator system VVCA combines the characteristics of the traditional road vibrator with the advantages of an all-terrain chassis. The vehicle has separate hydraulic pumps for vibrating, for the front and rear wheels, and for steering. The axles are individually steerable for cross-country manoeuvrability. Cruising speed on roads is up to 42 km/h. Both the vibrator power and the vehicle drive are obtained from one aircooled V6 or V8 Deutz Diesel engine.

The chassis and its vibrator are an integral design. It is a 'system' and not some accidental combination of a vehicle with a vibrator. The VVCA vibrator is capable of working on roads and highways as well as in rugged desert terrains. The unique 'lever-arm lift system' (patent applied for) without cables and vertical hydraulic columns, is practically maintenance-free. In operation the VVCA lift system provides a variable 'surface-to-baseplate contact angle' for optimum ground-to-vibrator coupling.

*Four VVCA vibrators generating shear waves, applying the "shover method"*





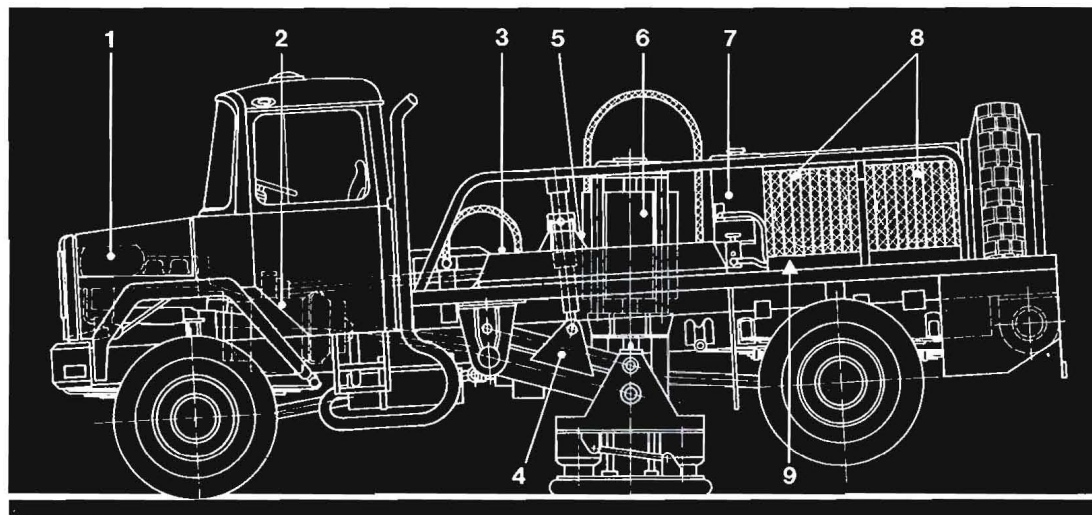
during operation in a town



## Some specifications:

Total Weight:	14 130 kg
Peak Force:	84.5 kN
Frequency Range:	8 to 115 Hz
Engine Power:	
– V6 Diesel:	129 kW at 2650 rpm

- 1 Diesel engine
- 2 Power transmission with power take-off
- 3 Axial piston pump
- 4 Lift system
- 5 Vibrator control unit
- 6 Vibrator unit
- 7 Hydraulic accumulators
- 8 Main hydraulic oil reservoir
- 9 Oil cooler



**VIBROSEIS survey at night**



**Side view of the vibrator system VVDA**

The vibrator system VVDA ist mounted on a cross-country Magirus-Deutz truck with an air-cooled Diesel engine, allowing speeds of up to 80 km/h.

The vibrator is driven by the truck engine itself via an automatic transmission with a variable input-capacity converter and power take-off (Voith-Certoplan). The same lever-arm lift system as used for the VVCA vibrator has been applied here in a slightly modified form (see vibrator VVCA).

The main advantages of the new VVDA vibrator are:

- High speed on roads
- All-terrain capabilities
- Low centre of gravity



## New Vibrators, Final Stage of Development

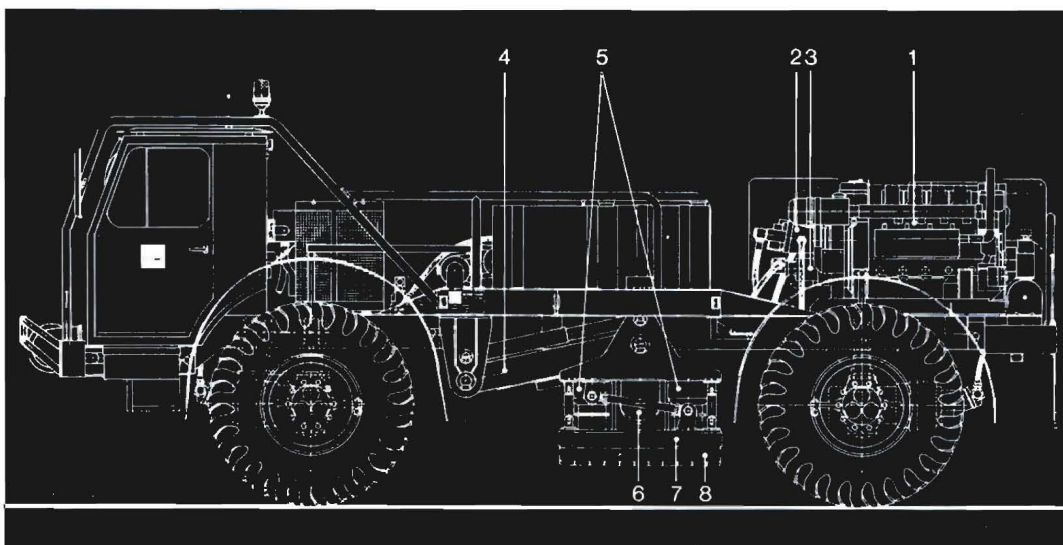
This new vibrator generation was designed to

- generate shear waves (VVCS) or
- enlarge the frequency bandwidth (VVCB)

## Shear-Wave Vibrator VVCS

### Some specifications:

Vehicle:	4 x 4 crab-tractor unit
Engine Power:	142 kW at 2150 rpm
Reaction Mass:	2500 kg
Peak Force:	170 kN
Frequency Range:	6 to 80 Hz
Interchangeable ground-coupling pads for road and rough country	



*Side view of the shear-wave vibrator VVCS*

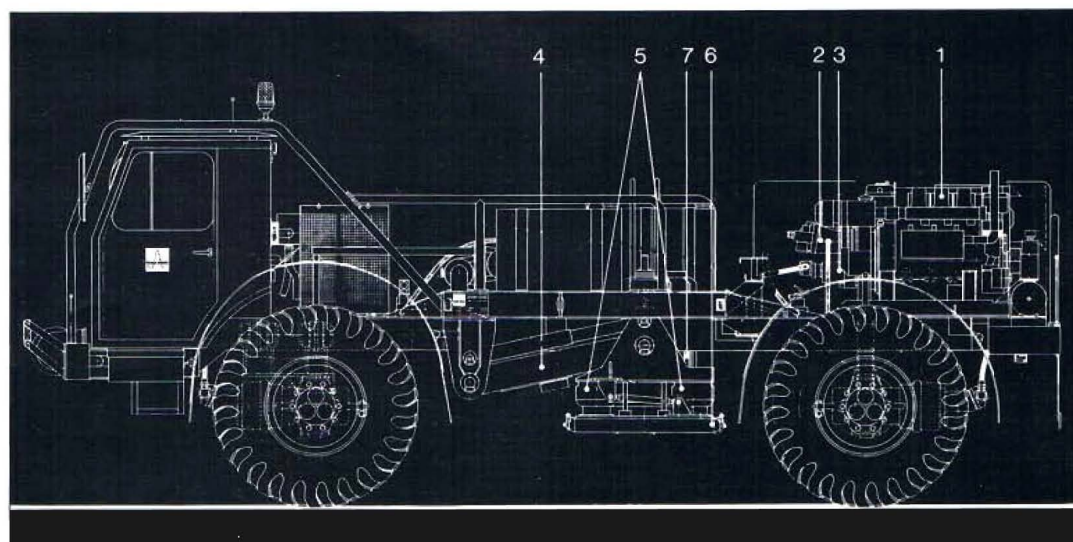
## Broadband Vibrator VVCB

### Some specifications:

Vehicle:	4 x 4 crab-tractor unit
Engine Power:	107 kW at 2150 rpm
Reaction Mass:	2500 kg
Peak Force:	84.5 kN
Frequency Range:	10 to 210 Hz
Baseplate:	1.85 m <sup>2</sup>

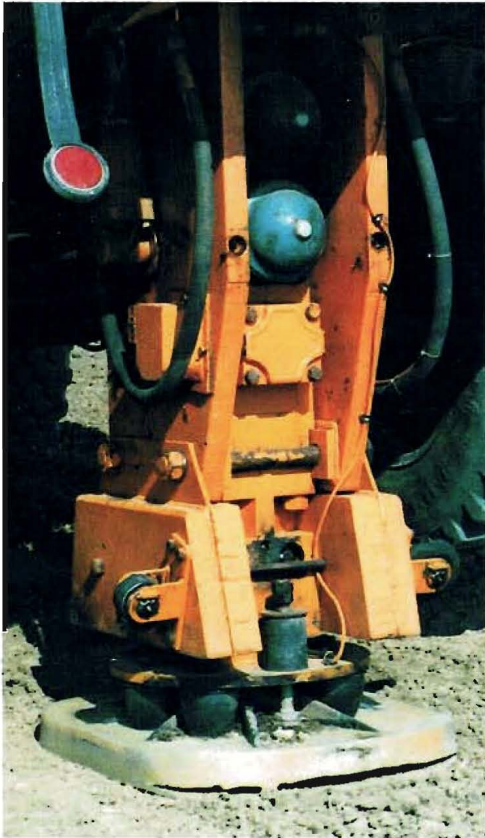


- 1 Diesel engine
- 2 Vibrator drive pump (250 l/min)
- 3 Wheel-drive pumps
- 4 Lift system
- 5 Air bags
- 6 Reinforced baseplate
- 7 Reaction mass



*Side view of the broadband vibrator VVCB*





## Other Sources

The **Hydraulic Hammer**, a well-established tool for

- ▷ Shallow to medium range reflection surveys
- ▷ Short-refraction surveys



*The Hydraulic Hammer is mounted on a Mercedes-Benz Unimog chassis. The hammer is triggered by remote control from the recording truck.*

### Specification

Total weight (truck + hammer):	5170 kg
Hammer-type:	HM 600 Krupp
Weight:	485 kg
Weight of piston:	50 kg
Piston-stroke:	~ 120 mm
Oil pressure:	130 to 150 bar
Energy of one blow:	~ 200 kgm
Blow sequence applied for field operations:	one blow per 3 to 5 seconds

Surface waves are effectively attenuated by working along patterns during vertical stacking.



*Not restricted to road operations*

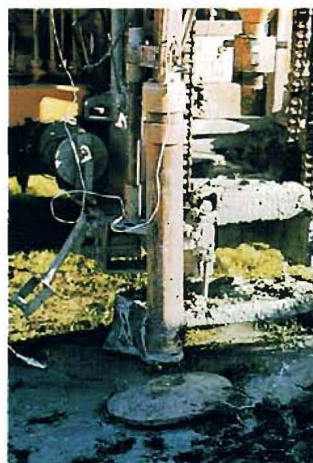


### Weight-Dropping Unit

mounted on a drilling rig, used for

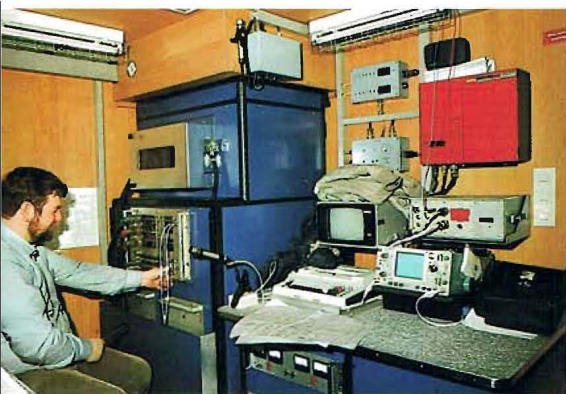
- ▷ Short-refraction surveys
- ▷ Down-hole surveys

especially in connection with VIBROSEIS surveys.



*Weight and baseplate*





**SERCEL SN 348 (left)  
Correlator Stacker CS 2502 (centre)  
Recording truck and container, in which  
the above units are installed (right)**

## Recording Systems and Accessories

### Impulse-Seismic Recording Systems

#### Capacities

- ▷ SERCEL SN 348 (Telemetry) with field units 480 channels, 4 ms SR  
240 channels, 2 ms SR
- ▷ SERCEL SN 358 120 channels, 2 ms SR
- ▷ TEXAS INSTRUMENTS DFS V 240 channels, 4 ms SR  
120 channels, 2 ms SR
- ▷ TEXAS INSTRUMENTS DFS IV 48 channels, 2 ms SR
- ▷ SERCEL S 338 B 48 channels, 2 ms SR
- ▷ TEXAS INSTRUMENTS DFS V, firedamp-proof for in-seam seismics in coal mining with inert gas controller and roll-along-switch

### VIBROSEIS® Recording Systems

#### Capacities

- ▷ SERCEL SN 348 with Correlator Stacker 2502 480 channels, 4 ms SR  
240 channels, 2 ms SR
- ▷ TEXAS INSTRUMENTS DFS V with CS 2502 120 channels, 2 ms SR
- ▷ TEXAS INSTRUMENTS Extended CFS I (DFS IV) 48 channels, 4 ms SR
- ▷ TEXAS INSTRUMENTS DFS V with ADD-IT IV 120 channels, 2 ms SR
- ▷ TEXAS INSTRUMENTS DFS IV with ADD-IT II, III, IV 48 channels, 2 ms SR

Vibrator controls used:

- Geosource Inc.: SHV-RCV 200
- Geosource Inc.: SHV-RCV 310 A and B
- Pelton Co. Inc.: Pelco Advance I

® Trade mark of CONOCO



◁ **Firedamp-proof recording system (DFS V) in a coal mine**



## Auxiliary Equipment

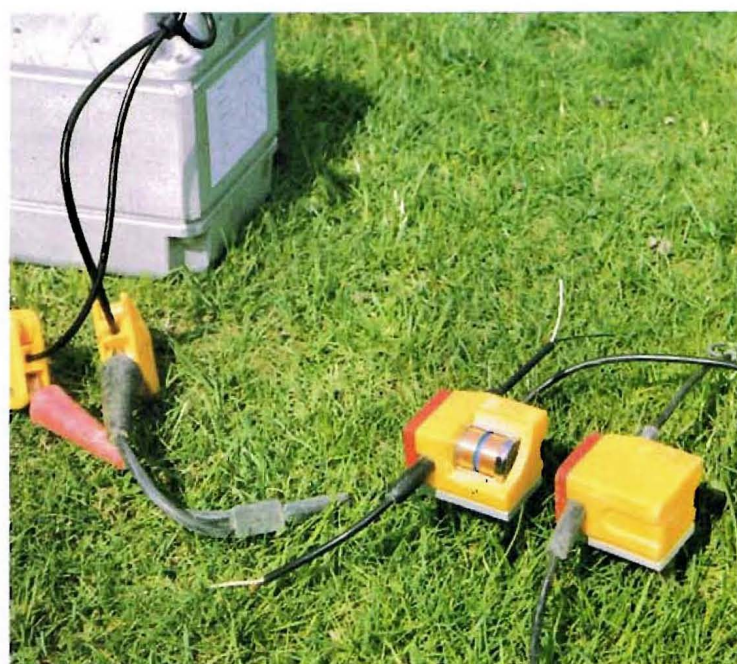
- ▷ Weathering-Survey Units:
  - Geometrics, type ES-2415 F combined with a tape recorder DMT-911 24 channels
  - SIE, type RS-44 24 channels
  - SIE, type RS-4 12 channels
- ▷ Remote Firing Control: PRAKLA-SEISMOS, type ZXDD



*Wall-clamped geophone (28 Hz)  
for in-seam seismics*

## Receivers

- ▷ Geophones:
  - Sensor SM-4, SM-7 10 Hz, as standard (also in marsh cases)
  - Sensor SM-7 ET 20 Hz, } for high resolution
  - Sensor SM-4 G, SM-7 GT 30 Hz, }
  - Sensor SM-6 8 Hz, horizontally orientated for shear-wave recording
  - Sensor SM-8 28 Hz, wall-clamped geophones for in-seam seismics
- ▷ Hydrophone
  - Geospace MP-24-L2 10 Hz, connected to bay cables to be used for lake and river crossings



*Horizontally orientated geophones (8 Hz)  
for shear-wave recording*

## Equipment Installation and Transport

*Standard recording truck:  
MERCEDES Unimog*



*Standard recording truck:  
MAGIRUS DEUTZ (IVECO)*







*Moving a seismic instrument cabin  
by helicopter in difficult mountainous area*

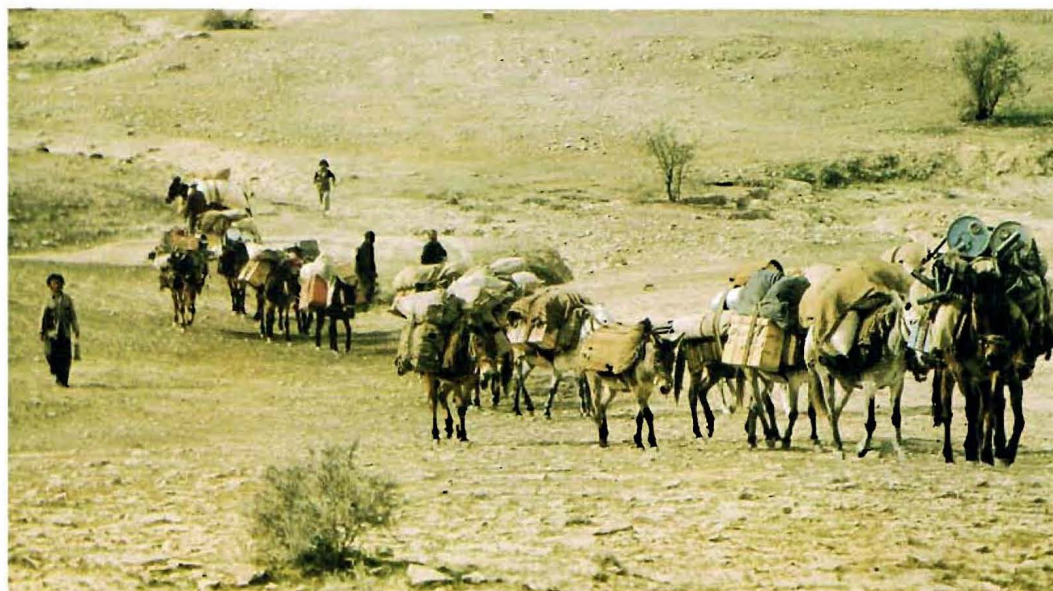
*The cabin being lowered (left)*

*...and prepared for use  
(left below)*

*A DFS V installed in the cabin  
(below)*



*A caravan of mules transporting  
spare parts, magnetic  
tapes and other supplies to the  
fly-camps and helicopter  
landing bases*





Service Department  
of PRAKLA-SEISMOS  
in Hannover



**PRAKLA-SEISMOS GMBH · BUCHHOLZER STR. 100 · P.O.BOX 51 05 30**  
**D-3000 HANNOVER 51 · FEDERAL REPUBLIC OF GERMANY**  
**PHONE: (5 11) 6 42 - 0 · TELEX: 9 22 847 + 9 22 419 + 9 23 250 · CABLE: PRAKLA GERMANY**  
© Copyright PRAKLA-SEISMOS GMBH

N 1500285