

Selection of experimental sites

On the basis of current understanding of the geo-hydrology and the spatial distribution of the various Histosols two sites (10 and 12) were selected (see Figure 9) for the experimental sites and were equipped with automated field stations. The observation wells provided water table depth measurements and solutes (Na, Ca, Mg, Cl, SO₄, and P) distribution across the Valley. Nine soil sites across the hydrological gradient from north to south were selected for intensive P analyses (fractionation, speciation, and sorption isotherms). About 250 soil locations across the Hula Valley were sampled for the determination of the degrees of P saturation and modelling its special distribution across the Hula Valley.

Previous research

There are more than 700 published papers and reports that describe the geology, hydrology, meteorology, agricultural issues, and socio-economical aspects of the Valley. However, there is only one short report (in Hebrew) that deals with P in the Hula Valley. This report strongly recommends various fertilization techniques to increase agricultural yield.

Equipment and measuring programme

The experimental site was equipped with four automated field research stations and devices for groundwater observation and groundwater sampling. Two of the groundwater stations were also equipped with automated Eh and pH electrodes. Continuous data collection from the automated field stations was coupled with regular and spatially intensive soil and water sampling across the Hula Valley (see Figure 2.9).

2.3 Equipment and recording program

Field equipment

All experimental sites chosen were **equipped with automated field research stations and devices** for ground water observation and soil solution **sampling**. Automated field research stations were running or under construction on sites of the Trebel Valley, the Droemling, and the Hula Valley at the beginning of the project. In the Hula Valley a series of automated measurement stations was operated along a hydrological gradient in a field where the water table is controlled by two parallel draining canals in which the water head can be adjusted. This enables the investigation of P mobilisation under controlled ground water levels and the setting of boundary conditions for

modelling. Figure 2.10 shows an example for the principal arrangement of measurement and sampling devices arranged to an automated field research station. The exact measurement and sampling depth can vary according to the Histosol profiles, ground water tables etc.

For matrix potential measurements the stations were equipped with electronic tensiometers at depths of 0.30 m, 0.60 m and 0.90 m. At each of these depths soil solution was collected by suction cups (in three replications) using a vacuum pump to generate approximately -50 kPa. Tensiometer measurements were recorded by a data logger. The vacuum pump was controlled by a clock timer, which enables us to collect samples according to the measuring protocol.

Groundwater table depths were measured in dip wells (gauges for the observation of surface near groundwater). They were drilled until a depths of 2 m below surface.

Soil moisture content was measured continuously by TDR soil moisture probes (IMKO, Ettlingen, Germany) at depths of 0.30 m, 0.60 m and 0.90 m.

Instrumentation was completed by the installation of redox electrodes, as redox potential is one of the key factors which influences P mobilisation. The redox potential was auto gauged by redox electrodes down to a depth of 1 m at steps of 0.1 m. Redox probes used platinum electrodes for measurement (for further details see Schmidt, 1998). The redox voltage was measured between the soil probe and a reference probe (Schott LTD, Mainz, Germany) installed in an adjoining dip well. The data measured in the field were corrected to the standard hydrogen electrode by adding 215 mV (10°C).

Tensiometer, TDR-stick probes, and redox electrodes were connected to a data logger for continuous registration and data storage.

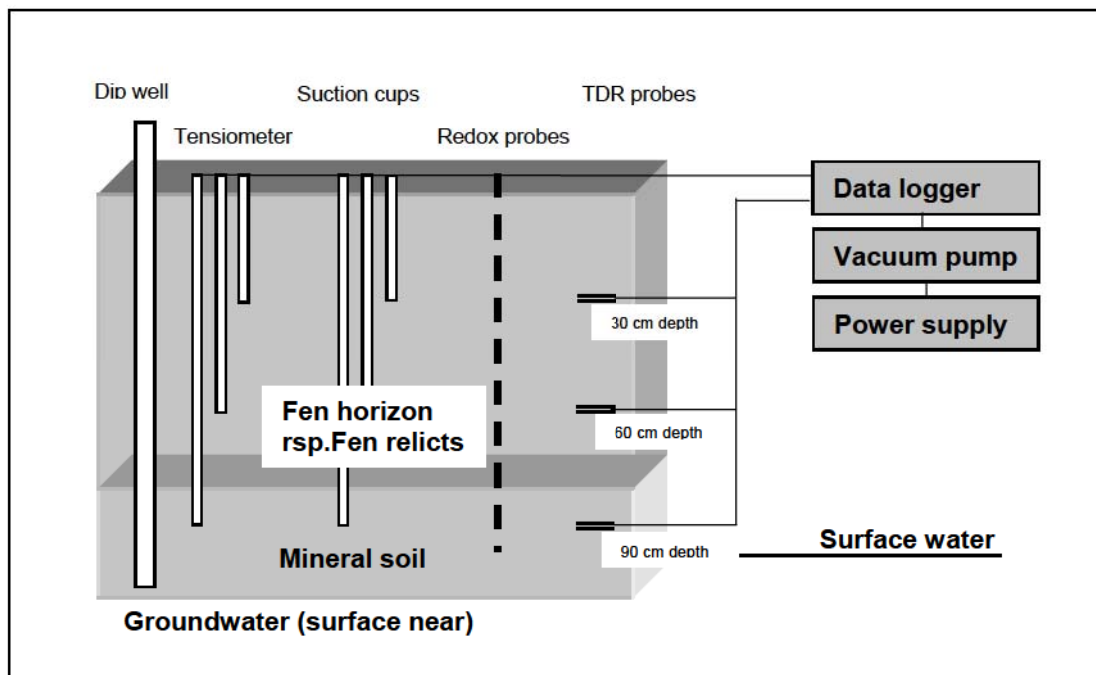


Figure 2.10 Principal arrangement of automated field research stations

Recording programme

Each group created a **database** on the hydrologic and pedologic (and climatic) factors of P mobilisation. The Lead Contractor aggregated data measured for the whole project.

Periodic measurements of pH, and samplings of soil, soil solution (suction cups), near-surface ground water and adjoining surface water were carried out at each experimental site. The soil profiles were sampled at incremental depths from Histosol profiles down to the mineral layer on shallow and down to 1 m on deep peat. Sampling enabled direct comparison of chemical data to the measured physical and redox properties at the relevant profile depth. Despite some special aspects at each site, a unified protocol for the measurements, sampling, sample storage and pre-treatment for analyses was developed. This enabled (1) quality control, (2) assignment of field data to chemical data, (3) sample exchange for special investigations without loss in quality, relevance, and (4) the development of strictly comparable data sets that allow later statistical determination of *inter-site* differences and provide a sufficient input to modelling.

Table 2.2 Sampling protocol for the compartments soil, soil solution, ground- and surface water

Compartment	Measurements	Measuring time period
Soil	Column (only UoR) / Batch experiments; for each layer (UoR) /mixed sample over the soil profile	Once, at the beginning of the investigations
	Soil moisture / temperature / tension / redox	Continuously logged respectively 3 weeks
	Total P, sorbed P, soluble P	3 months
	Oxalate and dithionite soluble Al and Fe	3 months
	Fe sorbed / dissolved	3 months
	Fe, Al (total digestion)	Once per year
Soil solution	Pt, MRP, DOC, (Al, Fe ³⁺ /Fe ²⁺)	3 weeks
Groundwater	Groundwater table	At least 3 weeks
	Pt, MRP, DOC, (Al, Fe ³⁺ /Fe ²⁺)	3 weeks
Surface water	Surface water table	At least 3 weeks
	Pt, MRP, DOC, O ₂ (pH, Redox, Temperature)	3 weeks

UFZ Report

**Program for the prevention of diffuse pollution
with phosphorus from degraded and re-wetted
peat soils**

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Science