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LOWER ATBARA RIVER PROJECT (SUDAN)
Bi-Monthly Progress Report (to 9th July
1982).

by

W M Edmunds

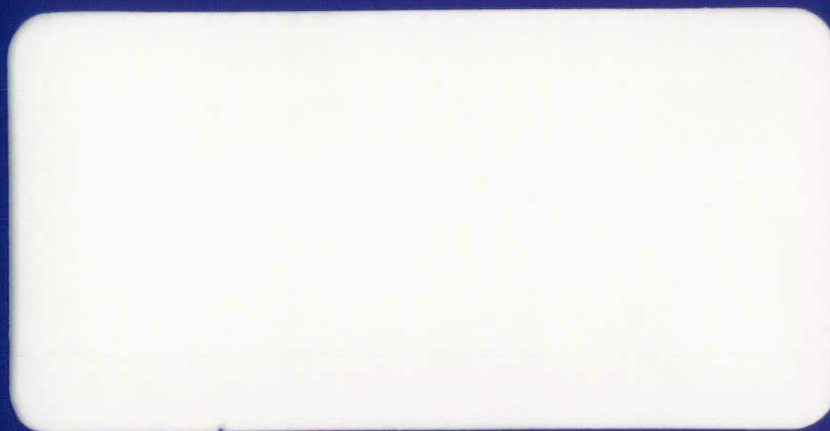


Institute of Geological Sciences

EPW/RH

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LOWER ATBARA RIVER PROJECT (SUDAN)

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1. WORK IN UK

Development of methods for analysis of stable isotopes ($\delta^{18}\text{O}$, $\delta^2\text{H}$) in soil moisture have been completed. Reproducible profiles in an unsaturated zone section in Cyprus, have been obtained, carried out on sealed flasks sampled in 1980. Precision on hydrogen isotopes is good (less than $\pm 2\%$) but for oxygen the precision is not generally better than $\pm 0.4\%$. Therefore future field work will concentrate on obtaining profiles of $\delta^2\text{H}$.

False colour photographs (Bands 4 to 7) have been produced for several trial areas of the Wadi Hawad. Comparative sets of photographs have been produced for the dry season and post wet season which show strong vegetational contrasts. Contrasts in the dry season photographs are believed to be related to soil types. A set of photographs was produced to be left in NAW Khartoum.

2. VISIT TO KHARTOUM (2 JULY-9 JULY 1982)

2.1 Objectives.

A visit was made by W M Edmunds and M J Howard (IGS) to Khartoum with the following objectives.

- (a) To check over all drilling and other project equipment sent by IGS.
- (b) To assemble the Pilcon and Winkie rigs and carry out test drilling in Khartoum.
- (c) To transfer equipment to the responsibility of NAW and discuss drilling methods to be used during the November-December drilling season.
- (d) To adapt one landrover (pick-up) for field augering.
- (e) To carry out further discussions with NAW (and ACSAD) on progress on field work March-July - base map production, rain-gauge, water sampling, dug well programme etc.
- (f) Discuss extension of satellite imagery work.
- (g) Discuss training programme.
- (h) To visit Abu Delaig area to inspect rain collection site, dug wells and carry out ground control inspection for satellite imagery work.

Meetings were held with project staff of NAW in Khartoum and Shendi and a visit was made to the field area in Abu Delaig. Unfortunately Dr Asaad (ACSAD) who had planned to be in Khartoum during this week, was unavoidably delayed and bilateral discussions only could be held.

2.2 Equipment and Drilling.

The contents of the container and airfreighted items had been stored carefully at the Kilo-10 site. All items were checked and a list of equipment in Sudan at 2 July 1982 is given in Appendix 1. The Pilcon Wayfarer 1500 rig was assembled at Kilo-10 in consultation with Sd. Moh Ali, head of drilling section NAW. The motor started well and all the accessories were found to be in a serviceable condition. It was evident that the drilling section had sufficient expertise in percussion drilling and extensive demonstrations were not considered necessary. It was agreed that NAW carry out trial drilling at Kilo 10 site as soon as possible to establish a technique, once a permanent driller can be assigned to the project. It was agreed that all the percussion equipment be transferred to a central location at Abu Delaig on or before 1 October 1982 and that the rotary accessories be left at Khartoum. The new towing bar supplied by IGS should be fitted to the Landrover.

The auger rig was assembled on the landrover pick-up and it was found that the engine was faulty. A replacement spark plug had to be found after which the drive gear was found to be satisfactory. Augering could not be carried out however, as the manufacturers had supplied the wrong sub with the auger reduction gear. A modified sub would be made up temporarily by NAW workshops and a new one also brought from UK. The drilling operations were discussed and it was estimated that 4 x 8 m holes per day would be practicable. Some surface casing (e.g. 4 x 0.5-0.8 m lengths of 4" or 6" metal pipe) must be prepared by NAW before the field work; this would prevent any contamination by surface material during drilling.

The other field equipment, PVC casing, Honda generator and Hilti drill (for sidewall coring) were inspected. These should be transferred to field location when convenient before November field season. Other field equipment - balance, etc. was already in Shendi and appeared to be functioning well. A new inverter for L/R power take off was left at Shendi.

2.3 Rain and Wadi Flow Sampling.

Discussions were held at Shendi, Abu Delaig and Khartoum to agree upon sampling during the rainy season. The IGS design raingauge (all polypropylene) had been copied using tinsplate sheeting rather than the PVC support. The original raingauge was installed at Sheikh Talha, ENE of Abu Delaig at the home of the meteorological officer. Additional samples would be taken from the main rain gauge at Abu Delaig. A note on rainfall collection is given in Appendix 2. New raingauges were to be installed also at Shendi and Khartoum (Kilo-10) under the supervision of NAW staff. At each station about 10 samples would be collected during the 1982 season.

Samples of wadi flow are to be collected at the main gauging stations of Wadi Hamad (near Kabuchir) and at Wadi Abratib (near Ben Nagar station). About 10 samples would be collected to provide a "chemical hydrograph" by Shendi project staff. These samples would be analysed at IGS.

2.4 Progress of Other Field Work.

The project HQ was now established at Shendi. The dug wells at Abu Delaig were visited and the main one (Dar es Salaam) was completed to the water table (26 m). Side wall samples were taken during this visit by NAW for elutriation of the interval 8-26 m; samples of elutriate would then be sent to IGS. A new dug well at Wadi Abu Talh (Shendi road crossing) was completed to 8 m; this section was predominantly clay and it was decided not to continue but to sample the side wall and keep it open as reference. Some valuable field work - well siting, sampling and hydrometeorological station construction work had been carried out in the area. Further work was still needed to produce good base maps of the area at 1 : 250,000 scale. These would be required before the November-December field season. Further details of field activities are given in the ACSAD and NAW progress reports.

2.5 Satellite Imagery and Ground Control.

The preliminary false colour photographs of Wadi Hawad area were left with NAW. An attempt was made during field work to identify main colour differences (dry season). It was concluded that the dark areas were an indication of clay soils, and white areas, sand or gravel areas. Further field work is necessary during November to improve the ground control, once better photographs are obtained. At this stage, however, it is clear that satellite imagery will serve as a valuable qualitative tool during the project.

2.6 Training.

Details of the Nairobi training seminar on satellite imagery (October 1982) were given to NAW. It would be valuable if one member of NAW could attend this course since it is not far from Khartoum and since it occurs at a convenient time for the project. It was suggested that anyone from NAW attending the course should meet Brian Little of EADD in Nairobi, following an introduction from the British Embassy, Khartoum.

Training needs were further discussed with Sd. Kheiralla Mahjoub. It was considered that the use of soil physics would be of value to the project and it was agreed that IGS would investigate the possibility of an input by Institute of Hydrology staff in this field. It was possible that a visit by IH staff could be made in November/December 1982 and a training visit by one NAW project member in first half of 1983 to Wallingford. If successful then a field programme could be set up to cover the 1983 rainy season. Details of the neutron probe equipment in Khartoum would be sent to IGS.

A further study visit by NAW staff (4-6 weeks) in chemistry/geochemistry related to the project is also considered desirable. The techniques used in the project are relatively straightforward, but require training to obtain precise and accurate results at the low levels (e.g. Cl⁻) encountered. It is desirable that a chemist or geochemist with NAW visit UK for training in the relevant techniques. In parallel it is desirable that a small laboratory (possibly the nucleus of the planned new laboratory) is set up in NAW for this work. At present the detailed analytical work is being carried out in UK but it is hoped that eventually this could be carried out in Khartoum.

It was also possible that one or more training awards (e.g. M.Sc. in Hydrogeology, Hydrology, Geochemistry, etc.) could be obtained in connection with the project for the year 1983/4.

2.7 Discussions with British Embassy.

Meetings were held with P Dixon (3rd Secretary Aid) and J Emerson. Mr Dixon, who replaced Ms James was briefed on the objectives of the project and met Moh. Khalafalla Ahmed, the Project Manager of the Lower Atbara project.

The future programme for the two Landrovers was discussed. The white pick-up was in full time use with the project and converted for shallow drilling; it would be based in Shendi or Abu Delaig. The other landrover had serious engine trouble and would be repaired in Khartoum, subject to a second estimate being obtained for the repair. It was agreed that this landrover should be handed over to the Embassy until October 1st when it would be required again for project field work.

The possibilities of training awards for the project were discussed via the Embassy, with Mr Tyler, British Council. He indicated that the allocations for 1982/3 were used up but that an estimate of any requirements for 1983/4 should reach him October/November.

3. SUGGESTED PROGRAMME FOR LATE 1982

Plans for next stages of field work were discussed with NAW. The following programme of work involving IGS staff in collaboration with both NAW and ACSAD is suggested.

3.1 Objectives.

- (a) Carry out auger traverses of different soil/land use types to assess recharge variability. It is envisaged that up to 4 profiles would be drilled each day to depths up to 8 m. This work would be within a 30 km radius of Abu Delaig.
- (b) Dug well programme. Around 1st October it is hoped that a further two dug wells can be started by the NAW team within 30 km of Abu Delaig. These should be on areas of flat sandy soil (similar lithology and well depth to Dar es Salaam).

Detailed sampling and resampling of the dug well sections will be undertaken using the existing method (scraping with an adze) and also by sidewall drilling (using the Hilti drill). Replicate samples for chemical elutriation will be taken. Profiles will also be taken for stable isotope analysis and possibly tritium.

- (c) Test drilling will be carried out using the Pilcon rig in the vicinity of Abu Delaig. This will establish whether dry drilling, as developed in Cyprus can be achieved in the Nubian sandstone lithology. If samples can be obtained, then at least two holes to >15 m will be drilled to compare with the other methods.
- (d) Following the above programme the Pilcon rig should be used to drill one or more observation well cross sections across either Wadi es Shelkha or Wadi Hawad - this programme should be agreed with ACSAD.
- (e) Make detailed well site map of Abu Delaig within a 10 km radius. This would form the basis of a detailed chemical sampling for analysis of Cl and other parameters at the water table. An assessment of input of NO_3 , SO_4 , Cl and other pollutants to the aquifer in the Abu Delaig town area would also be made.
- (f) Regional sampling to be carried out for carbon 14 in deep Nubian wells. Further reconnaissance chemical sampling in project area.
- (g) Carry out ground control study to investigate satellite imagery.

It is also probable that a visit by a member of the Soil Physics Section, Institute of Hydrology, to discuss a programme of soil moisture studies using neutron probe would be made at this time.

3.2 Logistics and Staffing.

Following discussions in Khartoum it was considered desirable to have one intensive period of field work involving all three groups sometime within the period November 11th to December 10th. For this, it was agreed to have a base camp (tents) within 4 km of Abu Delaig, using the rest house as laboratory and office. IGS would bring three people during this period.

It was agreed that in this way the maximum discussion and exchange of ideas could take place on the collaborative aspects of the project.

4. COMMUNICATION

A further report will be produced near to 1st September. Any data produced in the intervening period will be sent to NAW and ACSAD. A list of analyses is enclosed with this report to NAW and ACSAD only. It is important that frequent correspondence, by letter or telex is maintained, leading to the next field season.

It was agreed in Khartoum that a photographic record be kept of the project by all participants. This would be valuable especially for record of rainy season events. Maybe a cine film record of the project would also be valuable.

APPENDIX 1

Equipment at Kilo 10.

1. Percussion Equipment (in the yard)

Pilcon drilling rig (Wayfarer 1500) now fitted with ~40 m wire rope, snatch block, shackle and spring hook.

27 x 1.5 m x 6" diameter steel percussion casing

4 x 6" diameter claycutters (all fitted with tool shoes)

1 x 6" diameter shell

Spare tool shoes x 6

Spare steel clacks x 3

1 x 6" flat chisel

2 tapping down bars

2 x 6" casing driveheads

3 spare 6" casing shoes

1 reel 13 mm diameter wire rope ~60 m long

2. Pendant Rotary Equipment (in the yard)

10 x 3 m NWY drill rods

1 x 1.5 m NWY drill rod

1 x 1.5 m HWF core barrel

2 aluminium tubes ~4.5 m long

1 x rod vice

1 x rotary head

1 x vice table

1 pair 6" casing clamps

1 bracket (fits on aluminium tubes)

1 hydraulic ram (pulldown ~1.5 m long has hydraulic hose each end)

1 carriage assembly (has 2 pairs of rollers each side)

3. Accessories/Miscellaneous (in the store shed)

Honda 500W Generator

30 x 6 m x 70 mm ID plastic casing (perforated)

2 chain wrenches for 6" percussion casing

Wooden box containing engine and clutch spares (filters, hydraulic cylinders, valves, bearings).

3 hydraulic hoses

Front bumper for White Embassy Land Rover

APPENDIX 1 (Cont'd)

4. Winkie Drill and Accessories (last seen in Embassy Land Rover)

Winkie rig

Mounting bracket (fixed to front of Land Rover)

2 support bars (rig-windscreen)

(Wooden box containing 10 x 1 m x 3" diameter auger flights, 1 fishing tool, 5 auger bits, 1 'C' plate)

Fuel tank

Blue tool box

Wooden box containing auger reduction gearbox and red tool box

APPENDIX 2

LOWER ATBARA RIVER PROJECT (SUDAN)

Rainfall Collection Procedures.

1. Background

Rainfall and dry deposition are the primary means of solute input to the area. To carry out the geochemical study of recharge it is necessary to calculate the solute load being deposited at any one place and over the whole catchment. Previous work was carried out in Cyprus in a maritime region with chloride 14-18 mg/l, where Winter rainfall occurred. In Sudan not only is the rainfall regime different (summer, rains) but the airmasses have extensive travel over continental area. This means that the marine aerosol will be much depleted and that chloride levels will be of the order of 0.1-2.0 mg/l thus considerable care must be taken to collect and analyse at these low solute levels, to avoid contamination. As a background to stable isotope investigation it is also necessary to collect some rain samples.

2. Collection localities

To gain adequate regional coverage and sufficient statistical information it is proposed that rainfall sampling be carried out at Khartoum (Kilo 10) duplicate sample, Shendi, Atbara, Gedaref, Abu Delaig (duplicate sample) and at one other meteorological station yet to be decided in the lower Wadi Hawad. (During 1982 wet season probably only 5 collection stations are practicable).

3. Method of Collection

- (a) For the main collection network standard raingauges should be used. However personnel should be instructed not to handle the inside of the funnel in view of the risk of contamination.
- (b) The idea is to collect total deposition and therefore early rains or light rains might be important. In 1982 all raingauges should be installed by early May if possible.
- (c) At the end of each 24 hour period (e.g. 08:00 hours) the rainfall should be transferred to a clean storage bottle, (2.5 litre supplied by IGS). The measuring funnel should always be kept clean.
- (d) The daily samples should be bulked and after about 20 mm of rain a sample should be taken in the bottle provided and the remainder discarded.
- (e) The 150 ml bottle should be tightly screwed and kept in as cool a place as possible for storage. The bottle label should contain the following information, (i) site name, (ii) interval of collection, e.g. June 1-15th, (iii) volume of rainfall during this period (in mm).

- (f) At any convenient time the bottles should be centralised at Khartoum and subsequently airfreighted to UK.

4. Variations on the above Programme

A PVC raingauge designed for chemical sampling was brought from UK. A copy of this is being made by NAW in Sudan. These two raingauges are to be used to collect duplicate samples at Khartoum (Kilo 10) and at Abu Delaig.

At Khartoum (North), samples for oxygen and hydrogen stable isotope are being collected for the IAEA network. Additional samples should be taken in 30 ml glass bottles (provided) at Abu Delaig and Shendi at the same time as the chemical samples above. These additional samples will be sent to IGS laboratory for analysis.

Distribution:

| | | |
|------------------|---|---------------------------|
| Mr J Khouri | : | ACSAD (2 copies) |
| Project Manager | : | NAW Khartoum (2 copies) |
| Aid Secretary | : | British Embassy, Khartoum |
| Mr M B Grieveson | : | ODA |
| Mr D P Turner | : | ODA |
| Mr B G Little | : | EADD, Nairobi |
| Mr I G Hughes | : | ODIGS |
| Dr E P Wright | : | IGS |
| Mr D A Gray | : | IGS |
| Mr J B W Day | : | IGS |
| Dr A H Bath | : | IGS |
| Mr W G Darling | : | IGS |
| Miss J M Parker | : | IGS |