

LOWER ATBARA RIVER PROJECT (SUDAN)

NAW(Khartoum) - ACSAD(Damascus) - IGS(Wallingford)

BIMONTHLY PROGRESS REPORT, APRIL 30TH, 1982

by

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1. INTRODUCTION

Full details of the project are contained in the project document prepared by ACSAD (1981). This is the first IGS bimonthly progress report. It was agreed that an exchange of reports between participants be made on a bimonthly basis commencing end of April.

2. VISIT TO KHARTOUM (1 March 1982-11 March 1982)

A visit was made by WME and E P Wright (IGS) with the following objectives.

- (a) To initiate field activities for the project in collaboration with ACSAD and NAW.
- (b) To agree the joint field programme until the end of 1982.
- (c) To meet other organisations in Khartoum who might have a contribution to make to the project.
- (d) To carry out reconnaissance geochemical sampling of the Wadi Hawad area.
- (e) To sample prepared dug well sections for soil moisture/chemical analysis and to define techniques to be used subsequently during the project.

Discussions were held between IGS (WME, EPW), ACSAD (Dr Abdullah Al-Droubi and NAW (Sd Kheiralla Mahjoub, Director General, and Sd Mohammed Khalafalla Ahmed, Local Project Manager). These discussions centered mainly on logistic problems. During the visit, two Toyota land cruisers supplied by ACSAD had arrived in Khartoum. Following discussions with the British Embassy, two land rovers were assigned to the project, initially until July 1982 when the overall requirements would be reviewed. These land rovers would still be under the administrative control of the Embassy. However it was found that fuel was in very short supply and this could limit overall scope of field work. It also proved difficult to purchase basic supplies and provisions in Khartoum, as well as vehicle spares and it was clear that in future, more items would need to be imported from UK or Syria.

Visits were made to the Geological Survey Department where we were received by Dr Isshag who offered full assistance for the project. Prof. Almond (Department of Geology, University of Khartoum) expressed considerable interest in the project, especially in view of its proximity to Khartoum, and suggested that the area might offer a suitable student training ground in the area of sedimentary rocks. Help in rainfall collection was also arranged via the Meteorological Department.

3. VISITS TO FIELD AREAS

The NAW had arranged for two dug wells to be constructed close to Abu Delaiq. These were sidewall sampled at 20 cm intervals. Due to the difficulty of excavation into the wall by hand it was not possible to collect for soil moisture determination except at the depth of active excavation. Elutriation of samples for solute analysis was successfully carried out in the field. The succession, exposed in the wells was - soils (~1 m) overlying relatively soft Nubian Sandstone - partially carbonate cemented. It was considered that the formation would be ideal for additional sampling by auger drilling during subsequent phases of work. Rock exposed at the depth of digging (8 m) was moist and samples were collected for stable isotope analysis and moisture content.

Reconnaissance visits were also made to boreholes in the Wadi Hawad and Nile Valley areas where samples were collected for preliminary chemical and isotopic analysis.

4. VISIT TO DAMASCUS (11 March 1982-16 March 1982)

En route to UK, a visit was made by WME (IGS) to ACSAD Damascus to finalise the programme with ACSAD staff - Dr J Khouri and others who would be participating in hydrogeological work. It was agreed that a detailed field survey would be undertaken between April-June by ACSAD-NAW to ensure accurate well siting and provide a good hydrogeological data base. The main field activities would take place in November-December 1982 with a short planning visit by WME to Khartoum in July 1982.

5. PRELIMINARY RESULTS - SOLUTE PROFILES

Soil moisture contents of the two dug wells were measured on samples from ca. 8 m depth; they were 52 mg/g (Borehole 1) and 28 mg/g (Borehole 2).

Specific electrical conductance (SEC), chloride and nitrate were measured on elutriate samples on return to UK. Results are given in Figures 1 and 2.

The salinity of BH2 is an order of magnitude lower than BH1. This is consistent with the topography of the two areas - a lower salinity suggests more recharge at BH2 which was nearly flat, whereas BH1 site was slightly sloping.

The solute profiles both exhibit considerable oscillation with depth. It is possible that these represent variable inputs between wet and dry seasons, although more data is needed to show this. It is considered that both profiles represent a steady state downward transfer of soil moisture and that the mean chloride values can be used as in Cyprus to calculate C_s , the mean soil moisture composition. Using the relationship

$$R_d = P \cdot C_p / C_s$$

and substituting a value of 200 mm for rainfall at Abu Delaiq and a value of 1 mg/l Cl^- for mean rainfall composition a preliminary value of direct recharge may be calculated. C_s values are derived from the elutriate values of ~8 mg/l (BH2), ~100 mg/l (BH1) and a mean soil moisture value of 40 mg/g, giving 68 mg/l (BH2) and 850 mg/l (BH1). Therefore, a mean direct recharge value of 3 mm/yr is indicated for BH2 and 0.25 mm/yr for BH1.

Thus, the results of this first reconnaissance sampling demonstrate the effectiveness of using dug wells for measuring solute profiles. The results also demonstrate that direct recharge is taking place and, if for example 3 mm/yr were a general value this represents 3000 m³/km²/yr. The work clearly gives encouragement to extend the study - using dug wells and also using augered holes (e.g. to 5-8 m) drilled on a grid basis. It is noted that NO_3^- is quite high in relation to Cl^- at both sites.

6. PRELIMINARY RESULTS - ISOTOPIC AND CHEMICAL

Isotope analyses have been carried out on the regional samples, chemical results are so far incomplete. The data in Figure 3 show good correlation with the world meteoric line. Groundwaters from the Nubian (diamond) are isotopically light (-6 to -11 per mil) although these may well be mixed with heavier waters derived from current recharge. Current recharge in Abu Delaiq (e.g. 9 and 4) has a distinctively heavy composition compared with the Nubian. Deeper groundwaters in the Nile valley are clearly not solely derived from induced recharge from the river. These results shown that $\delta^{18}O$ and δD will be diagnostically valuable together with the chemical data during this study.

A distillation technique has now been developed for processing unsaturated zone moisture samples for δD and $\delta^{18}O$. Results for hydrogen ($\pm 2\%$) are, so far, better than for $\delta^{18}O$ ($\pm 3\%$). Trial samples from Abu Delaiq dug wells indicate that unsaturated zone moisture is of similar isotopic composition to water from dug wells.

7. SATELLITE IMAGERY

Three magnetic tapes have been purchased. One P186 R49 (30.4.81) of the Khartoum-Abu Delaiq area and two, P185 R49, of the area to the north, east and south of Abu Delaiq, taken on two dates (17.3.79, 13.9.79) before and after the rainy season. These two tapes are of very good quality and cover the area around Abu Delaiq and the Wadi Hawad. Preliminary work shows considerable differences between seasons and more detailed study of certain areas near Abu Delaiq is now planned, although some problems have been found with exactly matching the two scenes.

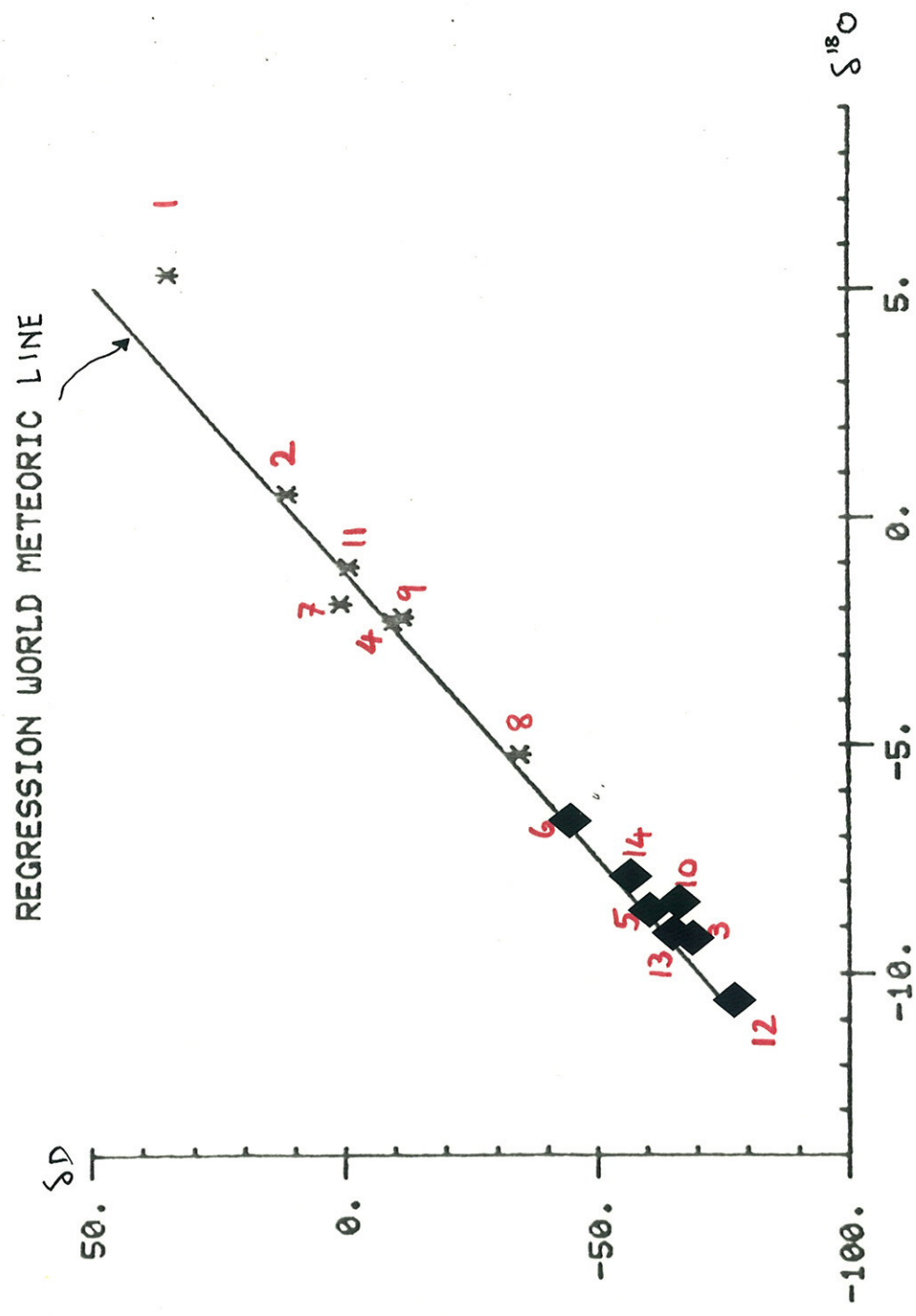
8. FUTURE PROGRAMME

A visit will be made to Khartoum by WME accompanied by M P J Howard (IGS) in early July. It is planned to arrive at 2330 on 2 July 1982 and to leave 0755 on 9 July 1982. The main purpose of this visit would be to check the contents of the container, now arrived from UK, and to assemble the drilling equipment at Kilo 10. Trial boreholes and auger holes would be drilled to test equipment and to discuss drilling methods with Sudanese drilling staff (who would then be responsible for all drilling after this visit). A further round of discussion would be held in Khartoum with ACSAD/NAW staff to review the progress of field surveys carried out since March. It may be necessary to spend 1 day in the field to visit meteorological stations to ensure good rainfall collection.

Distribution

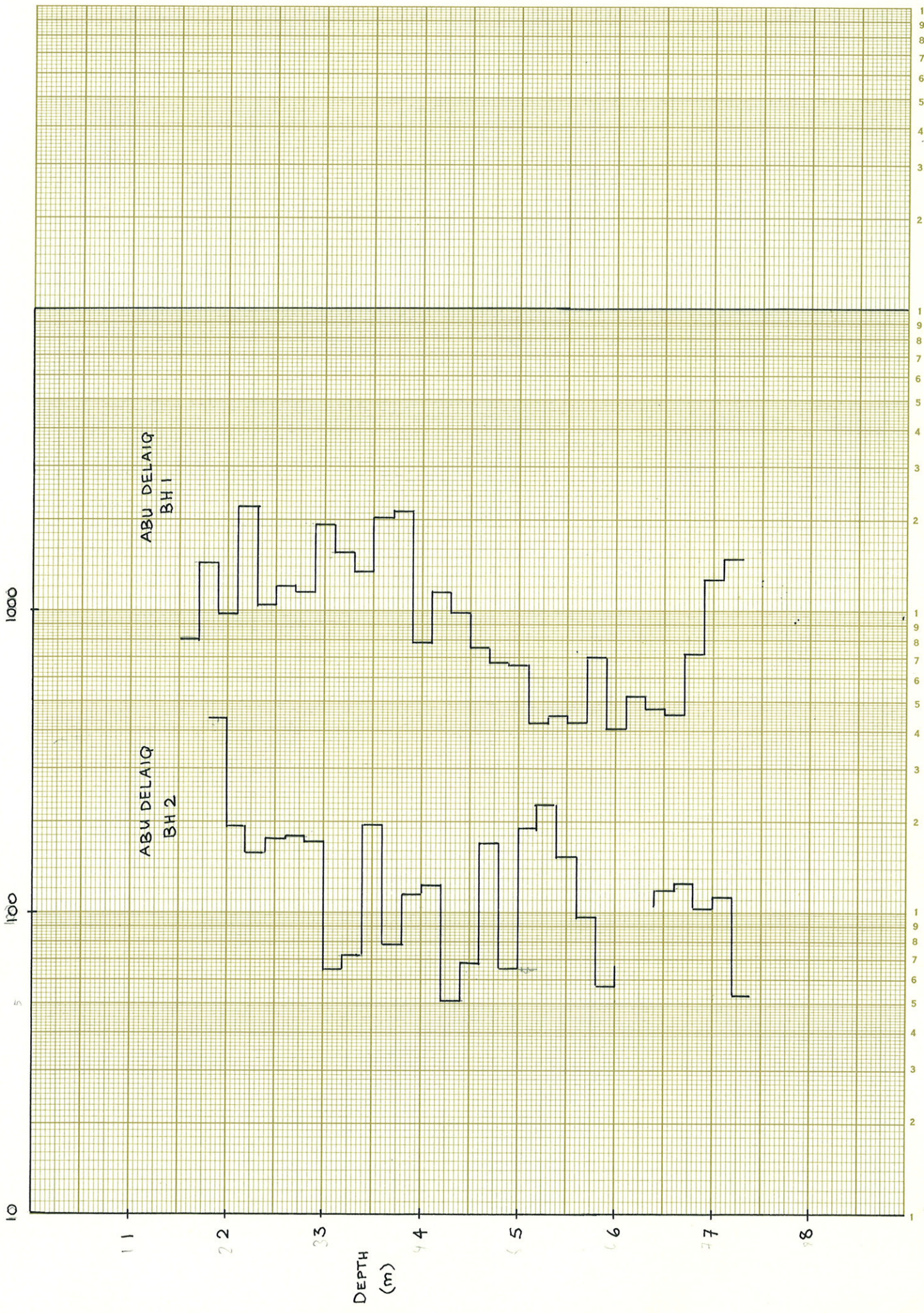
Dr J Khouri	:	ACSAD (2 copies)
Project Manager	:	NAW Khartoum (2 copies)
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Mr D A Gray	:	IGS
Mr J B W Day	:	IGS
Dr A H Bath	:	IGS
Mr W G Darling	:	IGS
Miss J M Parker	:	IGS

- 1 R. Nile, Shendi
- 2 R. Nile, borehole
- 3 EL Geheid
- 4 Bir Khabana
- 5 EL Stair
- 6 Tomeid Haj
- 7 Kabuchir
- 8 EL Gible
- 9 Dar es Salaam
- 10 Bir Wadi Hamad
- 11 EL Tomeid
- 12 Syeidab borehole
- 13 Bir Ben Nagar
- 14 Wad Hassani



Groundwater stable isotope compositions:
Lower Atbara River area
Sudan.

SPECIFIC ELECTRICAL CONDUCTANCE (ELUTRIATE) 25°C



CHLORIDE (ELUTRIATE)

