PN-ACB-238

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
Woods Hole Field Center
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ANNUAL REPORT

October 1996 - August 1997

Submitted to:
The Middle Eastern Regional Cooperation Program (MERC)
U.S. Agency for International Development

GEOPHYSICAL FRAMEWORK STUDIES OF THE DEAD SEA RIFT AND JORDAN AND ISRAEL

Prepared by

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Geophysical Institute of Israel, Israel

Grant No. TA-MOU-96-C15-165

US-AID Grant project officer
David W. Mulenex
U.S. Embassy, Tel Aviv

Project duration: October 1996 - September 1998

United States Department of the Interior

U.S. GEOLOGICAL SURVEY
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September 4, 1997.

US Agency for International Development
Center for Development Information and Evaluation
Room 215C, SA-18
Washington, D.C. 20523-1802

Dear Sir/Madam,

Please find enclosed one copy of the annual report on project TA-MOU-96-C15-165 *Geophysical framework studies of the Dead Sea Rift and Jordan and Israel.*

Sincerely,

Dr. Uri ten Brink
Geophysicist, U.S. Geological Survey

Executive summary

The project *Geophysical framework studies of the Dead Sea rift and Jordan and Israel* has two main objectives: (1) To assist in exploration of water and oil and in the assessment of earthquake hazard in Jordan and Israel. (2) To promote peace in the Middle East through scientific and economic cooperation.

The work plan for this project is aimed at fulfilling these objectives. The first 11 months of the project followed the work plan closely and achieved the following tasks:

1. Jordanian, Israeli, and American scientists met three times, once in Jordan, once in Israel, and once in the U.S., toured each other facilities, exchanged technical skills, and worked together in data compilation and analysis.
2. Jordanian and Israeli scientists carried out joint field work to measure common gravity points across their International border. These points were used to accurately merge the gravity data sets of Jordan and Israel.
3. Over 800 additional gravity stations were measured in Jordan and over 300 in Israel in places where data did not exist.
4. A combined data set for Jordan and Israel was established and is residing in the national archives of both Jordan and Israel. This data set is being updated periodically as new measurements are added.
5. Preliminary maps of Jordan and Israel and of the Dead Sea rift were produced.

The combined gravity data set reveals many faults and subsurface basins within the Dead Sea rift which were not known or were only speculated previously. The data set allows us to trace the actual fault segments which make up the Dead Sea rift, which is crucial for assessment of earthquake hazard. The newly discovered subsurface basins allow the mapping of aquifers and potential oil reservoirs with better accuracy. The data set also provides an unprecedentant detailed view of subsurface variations in rock composition along the rift valley for planners of infrastructure projects, such as the Dead Sea-Red Sea Canal.

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Figure 4 Shaded relief topography of Jordan and Israel, scale 1:2,500,000.

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Figure 8 (a) Bouguer gravity map and (b) Gravity contours superimposed on shaded topographic relief of the southern Araba (Arava) Valley showing the basins and fault traces discovered by this project. A-A' - Location of Figure 9.

Figure 9 Section across the deepest part of the newly-discovered Timna-Qa At Taba Basin in the southern Arava (Araba) from gravity modeling. See Figure 8 for location.

Preface and research objectives

The populated areas of Israel and Jordan comprise a single geological unit of the Dead Sea rift and its uplifted surrounding highlands. The different tectonic, geomorphic, and climatic factors which shaped the land in this region, have operated without regard to political boundaries. The two countries acknowledged the need to cooperate and as a result, this project was one of the five cooperative projects in Earth Sciences which were approved as part of the peace agreement between Israel and Jordan. The socio-economic benefits to this project are expected to be:

1. Determination of the thickness of young sediments filling the rift valley assist in the location of oil and water drilling and the estimation of potential oil and water reservoirs.
2. Mapping sediment thickness and subsurface faults assist in feasibility studies for the Red Sea - Dead Sea Canal, and in other large-scale development program along the rift valley.
3. Mapping subsurface faults to assist in earthquake hazard assessment.

The collaboration outlined in this grant is between the two prime government Earth Science agencies of Jordan (Natural Resources Authority) and Israel (Geophysical Institute of Israel). The collaboration includes joint work among different levels within these agencies: field technicians making joint measurements in the field, computer technicians working together in the lab, expert scientists making the interpretations and section heads of the agencies charting the overall direction. Thus, a large number of people from both countries will collaborate in the project, and in the process, will strengthen their professional and personal ties.

The following was our proposed time table for the accomplishment of the research objectives. The work plan for the first year followed this time table closely.

<u>First year</u>

(a) Collection of common gravity points.
(b) Collection of additional gravity points by each country in areas of sparse gravity coverage.
(c) Reduction and editing of gravity data collected by Israel and Jordan.
(d) Compilation of all available gravity data into a unified digital data base.
(e) Digitization of topography data base.

Second year

(a) Generation of gravity maps for various parts of the Dead Sea rift.

(b) Geological interpretation of the gravity data and preparation of reports.

(c) Interpretation and modeling of the regional gravity field and preparation of scientific manuscripts.

(d) Preparation of reports describing the application of the regional geological framework studies to earthquake hazard assessment, water and hydrocarbon exploration, and to infrastructure projects.

Accomplishments

The accomplishments are described below in the order listed in the time table. We are glad to report that all first year goals were accomplished with the exception of digitization of new topography data base for Jordan, and we have begun tackling the second year goals.

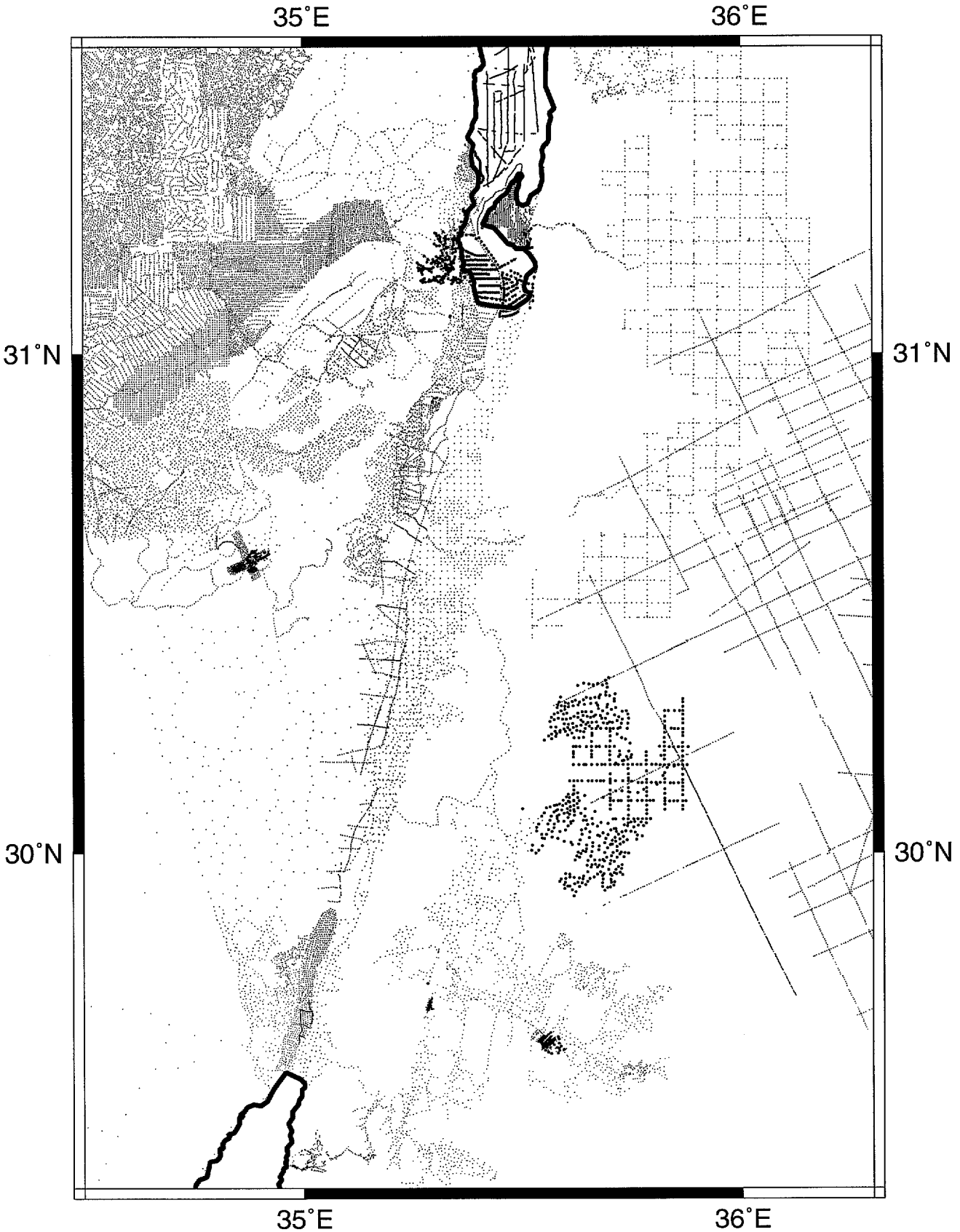
Collection of common gravity stations

Jordanian and Israeli national gravity base stations were twice occupied using two gravity meters of Lacoste & Romberg (model G880 and D20) and one Autograv Scintrex. Bet She'an and Sheik Hussein Bridge stations were tied on March 25, 1996. Aqaba Airport and Elat stations were measured on March 26, 1996. The difference between the Jordanian and Israeli reference gravity values is 14.93 ± 0.03 mGal.

Collection of additional gravity stations

More than 800 additional points were collected by the NRA in the Dead Sea salt pans and its vicinity, northeast of Aqaba, and in the Ma'an area (see Figure 1). GII has collected over 300 points in the Dead Sea salt pans and its vicinity. The Dead Sea salt pans of both Israel and Jordan are of prime economic importance. **The new gravity data confirm the existence of a fault crossing these salt pans.** In addition, this area has been the target of

Figure 1. Location of gravity stations. Stations measured since the start of the study are in red.



oil explorations for the last three decades and these data will better delineate the subsurface geology.

During our April 1997 meeting at GII offices and the August 1997 meeting at the USGS we made several recommendations to measure more gravity stations in key areas within the rift valley to help delineate some of the fault terminations and the exact shapes of basins. These measurements will take place in the near future.

Gravity measurements in the rugged western slopes of the Jordanian highlands have been delayed until a Global Positioning System (GPS) is purchased by the NRA. The GPS is necessary to measure elevations accurately in areas which can only be accessed by a helicopter. Funds for the purchase of a GPS system were included in the budget of this grant, and we expect the equipment to be purchased within the next 2 months.

Reduction and editing of gravity data

All the new gravity data stations were checked and reduced according to conventional procedures. These include calculation of instrument drift and tidal attraction, the conversion of field measurements to gravity values, the subtraction of the International Gravity Formula, free-air and Bouguer corrections, and Terrain correction, where possible. The Israel gravity data base was recalculated using a similar formula to the one used for the Jordanian data base and its reference value was shifted. As a result, both data bases could be merged and they both conform to the International Gravity Reference level. The gravity data of Jordan was edited for "noisy" measurements by M. Hassouneh using the Radian software during his April visit to GII.

Compilation of all available gravity data into a unified digital data base

The gravity data base of Jordan and Israel is now in a unified data base. This data base is being updated as more measurements become available. Free-air gravity anomaly and Bouguer gravity anomaly maps of Jordan and Israel have been produced (see Figures 2 and 3). These maps will be produced on a 1:750,000 sheet for a final product.

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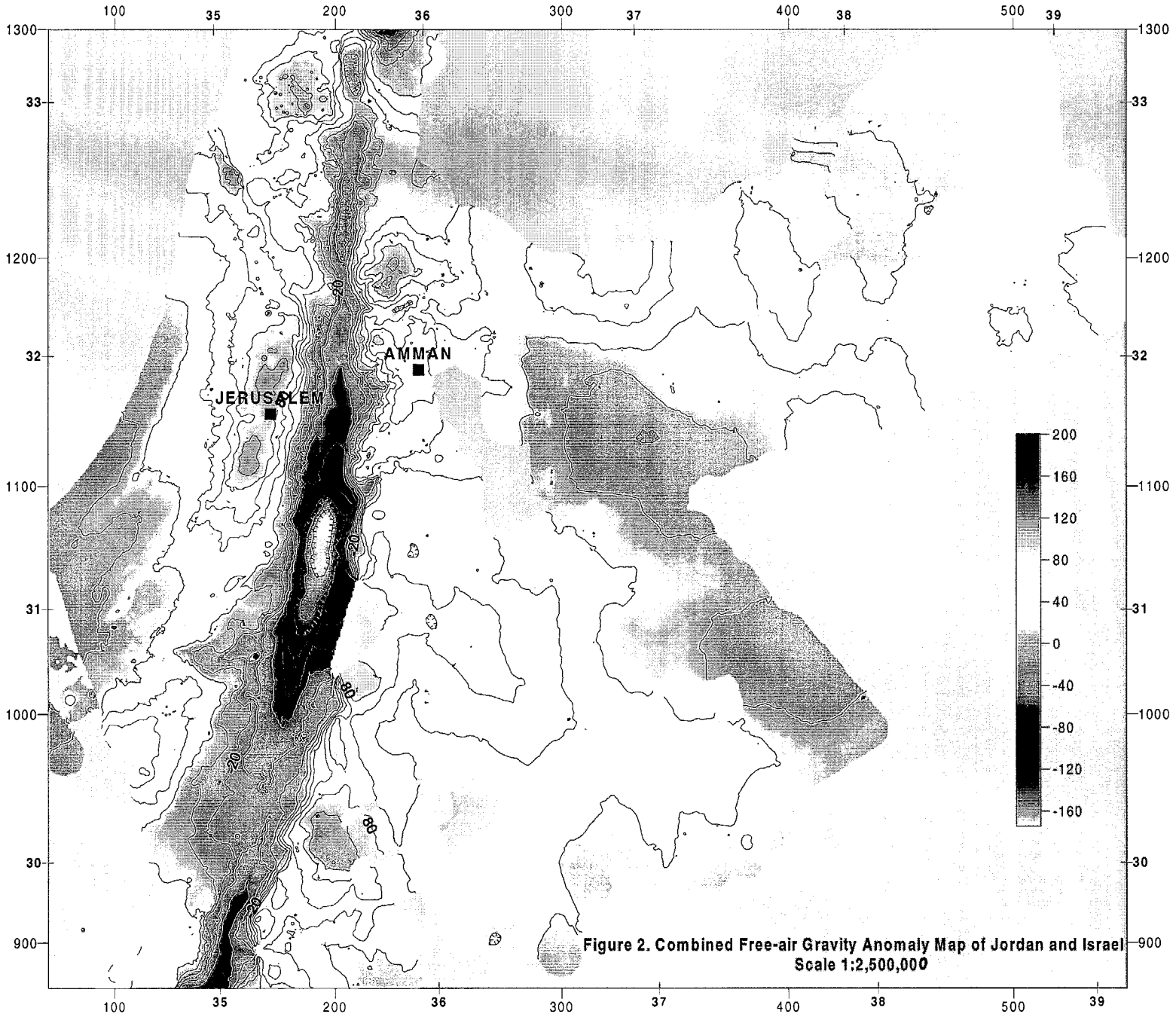

Figure 2. Combined Free-air Gravity Anomaly Map of Jordan and Israel
Scale 1:2,500,000

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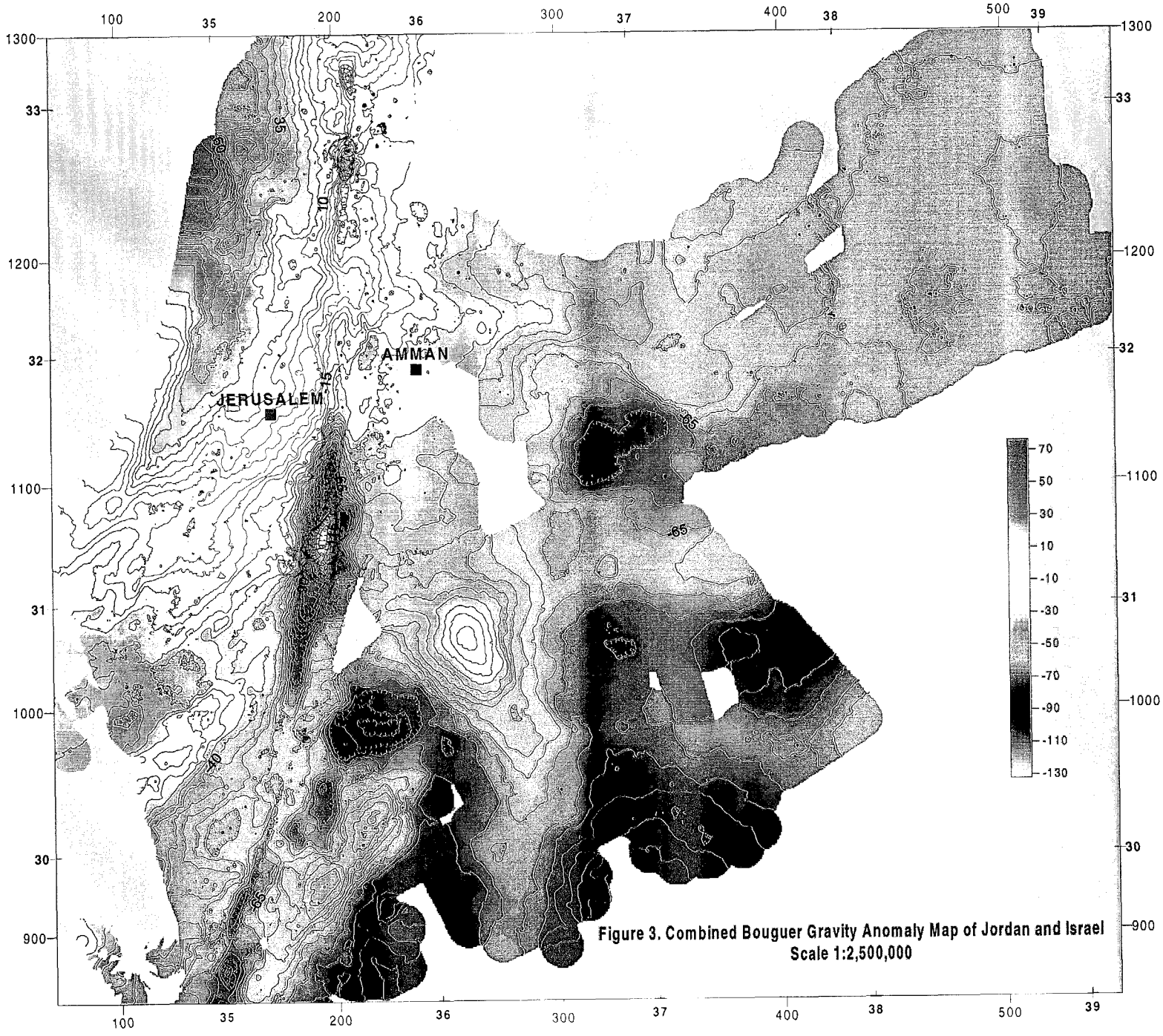


Figure 3. Combined Bouguer Gravity Anomaly Map of Jordan and Israel
Scale 1:2,500,000

Digitization of topography data base

Digital terrain elevation data base for Israel and the western slopes of the Jordanian highlands exists at a 25 meters grid interval (Hall, 1993). For the rest of Jordan we obtained a newly released Defense Mapping Agency grid at ~900 meters grid interval. The two data sets were compared where they overlap. Figure 4 shows a shaded relief topography for Jordan and Israel. In addition, we initiated contact between NRA officials and Dr. John Hall from the Geological Survey of Israel, who is willing to guide NRA in generating a digital terrain elevation data base for Jordan.

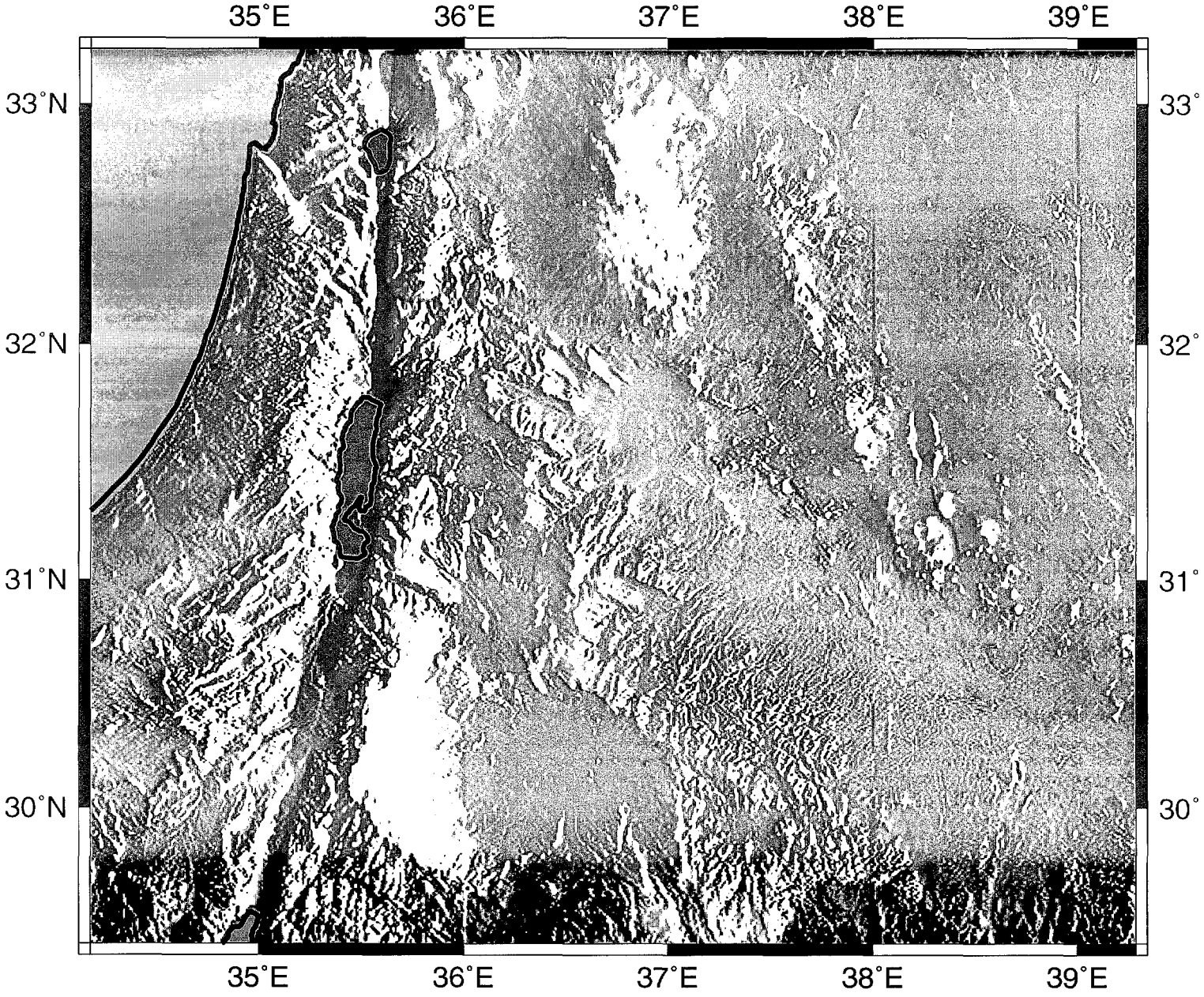
Generation of gravity maps for various parts of the Dead Sea rift

Bouguer gravity maps with a scale of 1:500,000 were generated for the Dead Sea rift and its vicinity (Figures 5, 6 and 7). The contour maps are overlain on a shaded relief topography of the area. This innovative representation facilitates the interpretation of features in the gravity map.

Preliminary interpretation - Discovery of a new basin and a fault and their implications to economic development

We briefly present one result from this project and discuss its economic significance. A detailed gravity and topography map of the southern Arava (Araba) Valley (Figure 8) indicates that the Aqaba-Elat sedimentary basin, which underlies the northern end of the Gulf of Aqaba (Elat), extends 20 kilometers northward on land. A new 30-kilometers-long and 8- kilometers-wide subsurface basin, estimated to be ~1200 meters deep (Figure 9) is located north of the Aqaba-Elat basin. We named the basin Timna-Qa' At Taba. The only traces on the surface are isolated drainage areas (Sabkha) near Yotvata and near Timna. By analogy to other parts of southern Israel and arid areas in the U.S., such as the Owens Valley, California, (Hollett et al., 1991), this basin is expected to contain the

Figure 4.Shaded Relief Topography of Jordan and Israel.Scale 1 to 2,500,000



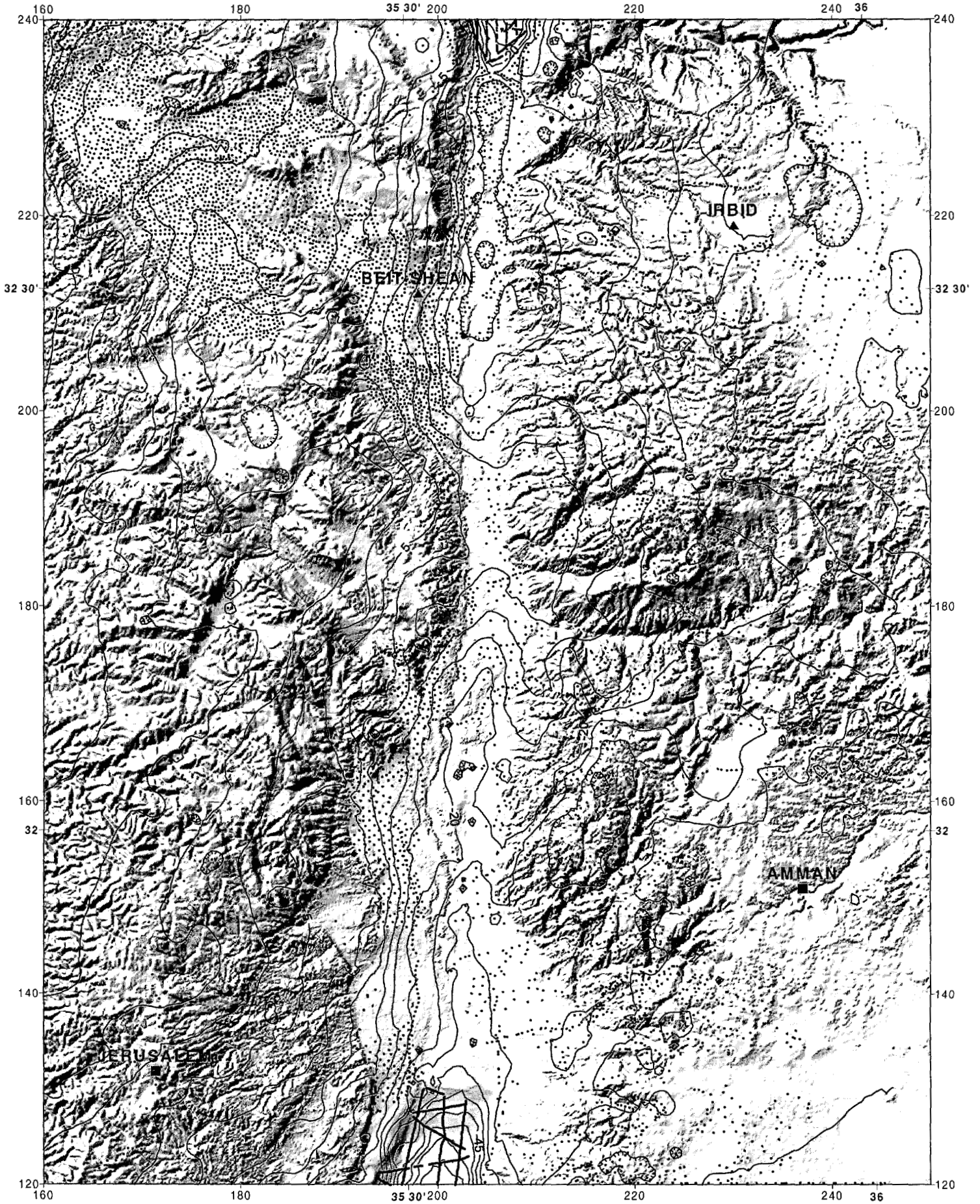


Figure 5. Bouguer gravity anomaly map and shaded topography of the Dead Sea rift and its surrounding. Contour interval 5mGal, Scale 1:500,000, Northern sheet. Blue dots denote gravity stations. Digital topography after Hall (1993).

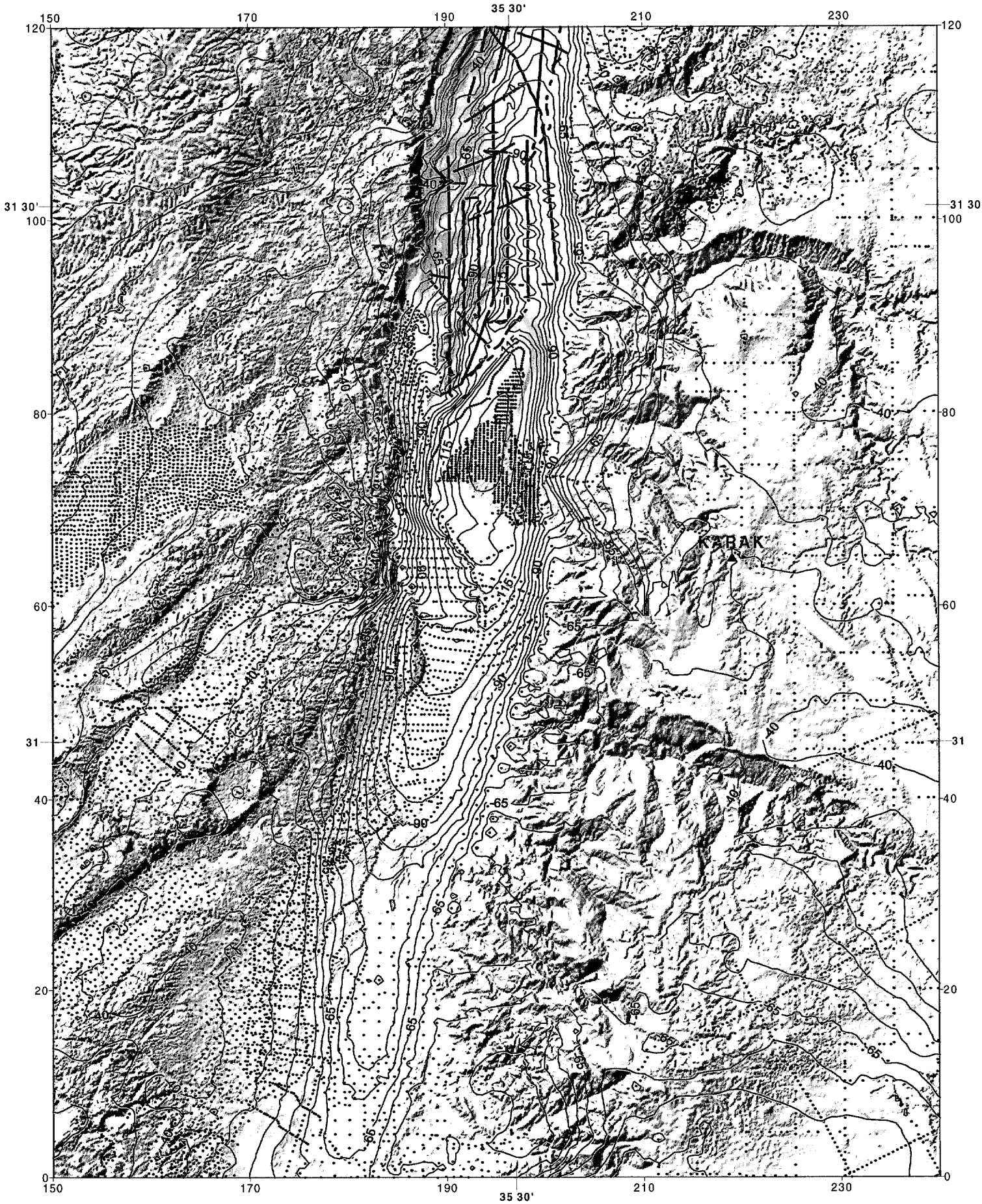


Figure 6. Bouguer gravity anomaly map and shaded topography of the Dead Sea rift and its surrounding. Contour interval 5mGal, Scale 1:500,000, Central sheet. Blue dots denote gravity stations. Digital topography after Hall (1993).

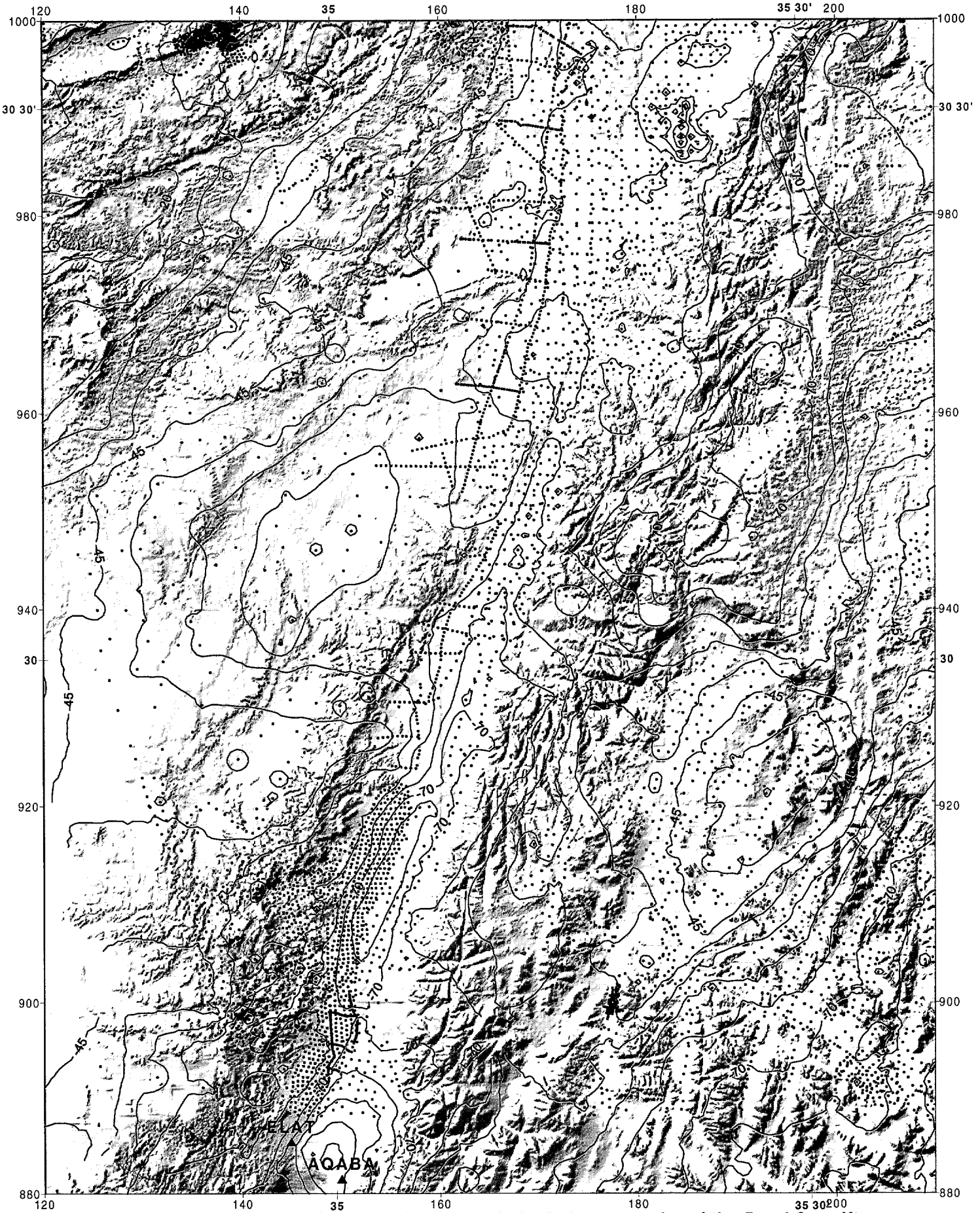


Figure 7. Bouguer gravity anomaly map and shaded topography of the Dead Sea rift and its surrounding. Contour interval 5mGal, Scale 1:500,000, Southern sheet. Blue dots denote gravity stations. Digital topography after Hall (1993).

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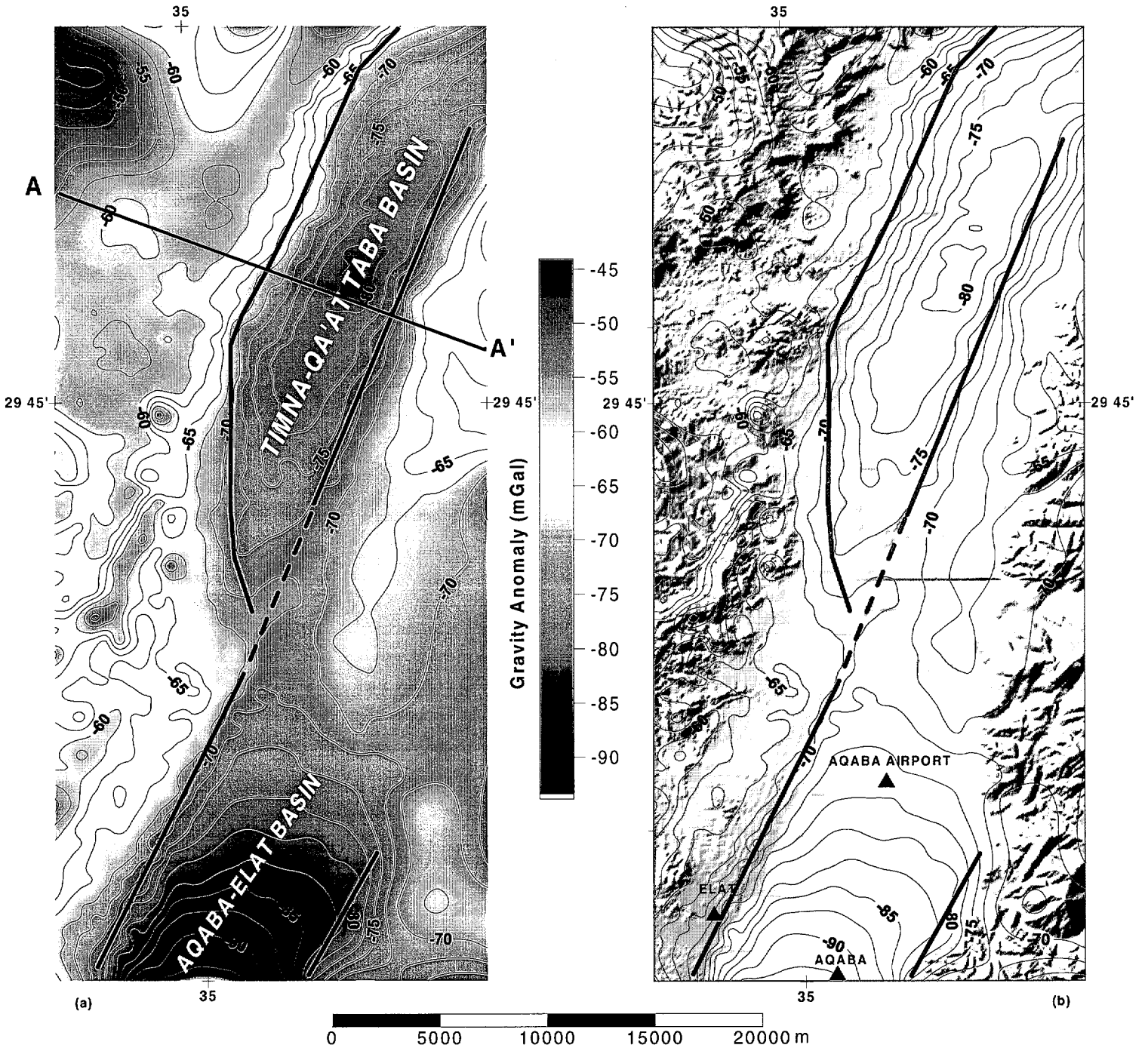

Figure 8. (a) Bouguer gravity map and (b) Gravity contours superimposed on shaded topogrophic relief of the southern Araba (Arava) Valley showing the basins and fault traces discovered by this project.

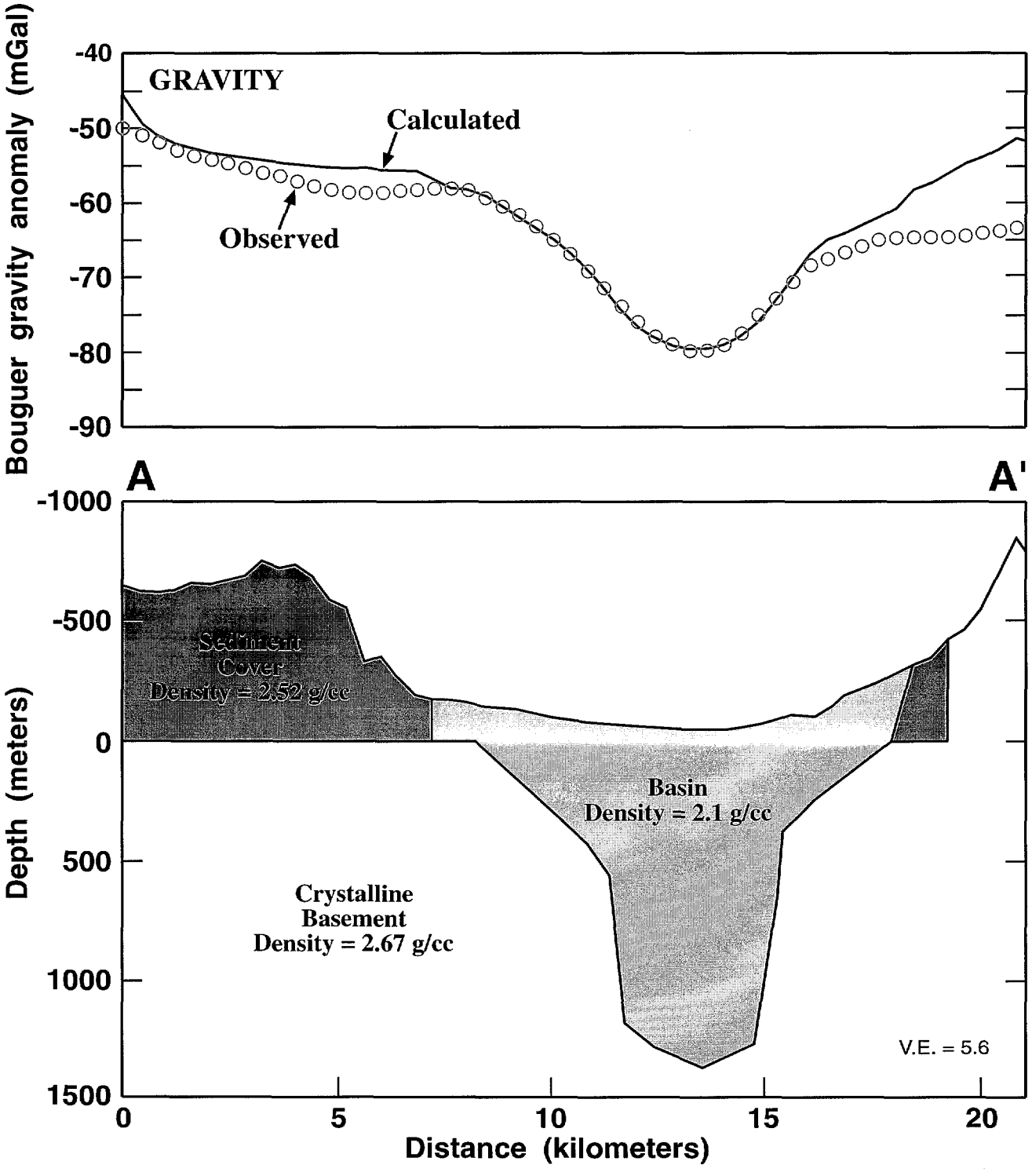

Figure 9. Section across the deepest part of the newly-discovered Timna-Qa AtTaba Basin in the southern Arava (Araba) from gravity modeling. See Figure 8 for location.

regional aquifer(s) in the area. It is unlikely that this basin serves as a hydrocarbon reservoir.

The new basin was formed as a result of motion on overlapping segments of the Dead Sea fault system. The fault extending north from the Gulf of Aqaba (Elat) terminates about 10 kilometers north of the city of Aqaba. The motion on the Dead Sea faults system is then transferred to the west to another fault which starts south of the city of Elat. This fault continues through the city of Elat, crosses the rift valley diagonally and ends about 40 kilometers to the north against the Jordanian highlands near Wadi Rahmeh. The motion is then transferred westward again to another fault which diagonally crosses the rift valley (Figure 8).

The fault extending northeast from Elat is much longer than was marked on previous geological maps. The magnitude of an earthquake is linearly related to the length of the ruptured fault. Hence, the determination of this fault length allows us to determine the maximum expected earthquake magnitude on this fault. The location of the fault trace through the city of Elat and a few kilometers west of the Aqaba Airport poses a potential danger to these places. The arrangement of fault segments in this area is significant because recent seismic activity along the Dead Sea rift tended to concentrate in areas where faults overlap.

Transfer of Technology

One of the stated purposes of this joint project is the share of technology and expertise. The following has been or will be achieved in the first year of the project:

Dr. A. Batayneh and Mr. M. Hassouneh learned to use SURFER and GRAPHER, commercial GIS software on Windows95, which allows manipulation of data, gridding, and contouring and the overlay of different data sets such as topography and gravity. Figures 2, 3, 5, 6, 7 and 8 were made with this software.

Dr. Michael Rybakov familiarized himself with GMT, a Unix-based free software for geophysical data manipulation, gridding, and contouring. Figures 1 and 4 were made with this software.

A PC computer installed with Windows95 and applicable GIS software software will be purchased by GII for NRA and transferred to NRA.

A differential GPS system will be purchased by GII for NRA and transferred to NRA.

Scientific Cooperation

The parties involved in the work met three times during the first year of the project and twice in the field for joint measurements of gravity stations.

U. ten Brink (USGS) visited GII during February 22-March 1, 1997. Y. Rotstein, M. Rybakov (GII), and U. ten Brink (USGS) visited NRA during February 25-26. They met with K. Sheyyab, the General Director of NRA and his deputy, K. El-Kaysi and were shown the NRA facilities. The work plan for the first year and the location of new measurements were discussed with M. Jaradat, Director of Geophysics and Technical Services Directorat, who is responsible for gravity measurements in Jordan and with M. Daoud, the Head of Geophysics Division. A. Al-Zoubi and A. Batayneh showed the visitors the computer facilities and software used at NRA and Al-Zoubi introduced the visitors to the Petroleum Club of Jordan and to M. Abu-Ajamieh, a noted Jordanian geophysicist.

U. ten Brink (USGS) visited GII during April 2 - April 27, 1997. M. Hassouneh (NRA) visited GII during April 11-17, 1997. Together they examined carefully the data quality of the two countries and edited out erroneous measurements. They also proceeded to plot preliminary joint maps from parts of the data set. M. Hassouneh was trained in the use of Surfer and Radian softwares. Together with Y. Rotstein they set goals for the continuation of Year 1 work.

A. Batayneh (NRA) and M. Rybakov (GII) visited U.S. Geological Survey office in Woods Hole, MA during August 10 - September 7, 1997, and Y. Rotstein (GII) visited Woods Hole during (August 15-19, 1997). Together they completed the compilation of the data and the preparation of the report presented here. A. Batayneh was trained in the use of Surfer software and Rybakov was introduced to GMT software.

Future Work

We plan to proceed in accordance with the original work plan. More gravity measurements will be carried out in the next few months in areas identified as crucial following our preliminary compilation and interpretation. NRA personnel will become familiar with the GPS equipment, which promises to greatly accelerate the measurement of gravity stations in rugged terrain. Final gravity maps for various sections of the Dead Sea rift and its vicinity will be drafted at 1:100,000 scale and will be accompanied by geological interpretation. Reports describing the impact of the study to earthquake hazard assessment, water and hydrocarbon exploration, and infrastructure projects will be prepared. A poster describing the results will be given at the international meeting of the American Geophysical Union in San Francisco in December 1997. An article will be prepared for publication in the journal Nature showing the gravity maps along the Dead Sea rift and their interpretation. Our next meeting is planned for Late October - Early November, 1997 and will take place partly in Jordan and partly in Israel with all three parties participating.

Special Concerns

Nothing to report.

References cited

Hall, J.K., 1993, The GSI terrain model (DTM) project completed, Israel Geological Survey Current Research, vol. 8, pp. 47-60.

Hollett, K.J., McGaffrey, W.F. and Walti, C.L., 1991, Geology and water resources of Owens Valley, California: U.S. Geological Survey Water-Supply paper 2370-B, 77 p.

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THE GEOPHYSICAL INSTITUTE OF ISRAEL המכון הגיאופיסי לישראל
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פרויקטים-8035

September 10, 1997

Mr. David Moulinex
Scientific Attache
U.S. Embassy
71 Hayarkon Street
TEL AVIV 63432

Subject: AID Grant No. TA-MOU-96-C15-165

Dear Mr. Moulinex,

Enclosed please find two copies of the Annual Report for the project "Geophysical framework studies of the Dead Sea rift in Jordan and Israel" (AID Grant number as above). We also enclose copies of the financial report.

Much of the activity relating to this project took place in August and early September during the visit to Woodshole of the Israeli and Jordanian partners. The expenses related to this trip are not final and are, thus, no included in the present financial statement. In addition to advance payment requested by the Jordanian NRA for the purchase of GPS has not yet been used. Our involvement helped to reduce significantly the price the NRA is required to pay in Jordan by supplying them with a price quotation from Israel.

I would also like to note that both our Jordanian colleagues and ourselves regard this project as a great success and as an example of productive cooperation and the benefits it can bring. The unified data base from the two countries has enabled, for the first time, an analysis of the structure of the entire Arava basin. The emerging structure has practical implications for important topics such as earthquake hazard assessment and optimization in water exploitation.

The cooperation itself is also very successful and has helped to bring the organizations as well as individual scientists closer together.

Yours sincerely,

Y. Rotstein

Dr. Yair Rotstein
General Manager

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THE GEOPHYSICAL INSTITUTE OF ISRAEL המכון הגיאופיסי לישראל
P.O.B. 2286, HOLON 58122, ISRAEL., TEL: 972-3-5576050, FAX: 972-3-5502925 רח' המשביר 1 חולון,

8033-פרויקטים

September 10, 1997

Mr. Boaz Ayalon
U.S. Embassy
ECON/AID Section
71 Hayarkon Street
TEL AVIV 63432

Subject: AID Grant No. TA-MOU-96-C15-165

Dear Mr. Ayalon,

Enclosed please find the Actual Disbursements Report pertaining to the above project for the period October 1996 to July 1997.

Yours sincerely,

Aliza
Aliza Tzitrin
Accounts Department

Encl.

8033.DOC

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AID Grant No. TA-MOU-96-C15-165

ACTUAL DISBURSEMENTS REPORT

Grantee: The Geophysical Institute of Israel (GII)
Grant Number: AID Grant No. TA-MOU-96-C15-165
Period covered by this report: from October 1996 to July 1997

BUDGET LINE ITEM	BUDGET			DISBURSEMENTS THIS PERIOD			CUMULATIVE DISBURSEMENTS
	GII	Jordan	U.S.A.	GII	Jordan	U.S.A.	
Salaries	24,000		21,000				
Materials & supplies	4,000	4,000		2,950			2,950
Equipment	0	70,000					
Travel	10,000	16,000	16,000	657	7,532	3,563	11,752
Other direct costs	5,000						
Assessment			20,600			1,513	1,513
Indirect costs	6,000						
TOTAL	49,000	90,000	57,600	3,607	7,532	5,076	16,215

Comments:

1. Please attach a separate Request For Payment Form for each grantee!

Note: All amounts in U.S. Dollars ($)

The undersigned hereby certifies: (A) that payment of the sum claimed is proper and due and that appropriate refund to AID will be made promptly upon request in the event of disallowance of costs not reimbursable under the terms of the agreement; (B) that information on the fiscal report is correct and such detailed supporting information as AID may reasonably require will be furnished promptly to AID on request; (C) that all requirements called for under the agreement to date of this certification have been met.

BY: G. Rotstein

Dr. Yair Rotstein

TITLE: General Manager THE GEOPHYSICAL INSTITUTE OF ISRAEL

DATE: September 10, 1997

10/09/97
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Appendix: Attached media coverage of the project

The following is a summary of three articles in Hebrew about this project.

(A) 6/7/97 - Article in the Israeli daily "Ma'ariv" about cooperation in assessing earthquake hazards and in oil exploration in the southern Arava Valley and in other parts of the Dead Sea rift, funded in part by the U.S. State Department.

(B) 6/10/97 - Article in the Israeli daily "Ha'aretz" describing the joint gravity mapping project between the NRA, GII, and the U.S. Geological Survey, which is funded by the U.S. State Department. The article mentions that this is first-ever public cooperation in geophysical research with an Arab country.

(C) 7/13/97 - - Article in the Israeli bi-weekly "Industries" describing the joint gravity mapping project between the NRA, GII, and the U.S. Geological Survey, which is funded by the U.S. State Department.

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עסקים - מעריב - 6/7/97

מחקר

הסיכון לרעידות אדמה, בערבה

■ ישראל וירדן ישתפו פעולה בהערכת הסיכויים והסיכונים לרעידות אדמה בערבה, בעיקר ספוף לאילת ועקבה ובן יבצעו במשותף סקר להיתכנות של שרות נפט ומחצבים אחרים באזור הגבול ביניהן.

הירדנים וקוקים בדחיפות למידע על הסיכון לרעידות אדמה מאחר שבכוונתם להקים מעקבה ותחנת כח חשמלית.

פרסים אלו נמסרו בעת ביקורה של משלחת בכירים של רשות המחצבים הירדנית במכון הגיאופיסי בישראל.

הירדנים מבקשים להסתייע במרשור החדש שמפעיל המכון הישראלי, בכוונת ירדן לבצע סקר גיאופיסי בשוטות הדשנות ובלתי הרסניות באזור עקבה. חלק מהפרוטקט ימומן בידי משרד החוץ האמריקני שיזנוף הפעולה המתוכנן בין ישראל לירדן יד אפשר לאחר מפות יחודיות לגרשא הפוטי הנפט.

ד"ר יאיר רוטשטיין מנהל המכון הגיאופיסי מסר כי זהו שיי תוף הפעולה הגלוי הראשון של המכון עם מדינה עוינת.

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10.06.97 יום ג'

אנרגיה / עמירם כהן

המכון הגיאופיסי מבצע מיפוי תת קרקעי באזור עקבה

המכון הגיאופיסי לישראל מבצע לאחרונה סקרים גיאופיסיים של תת הקרקע באזור עקבה בירדן. הסקרים נועדו לשתי משימות חכנון לדר עידות ארכיאולוגיות שעומדים הירדנים לבצע באתר ארכיאולוגי בעקבה (אילת העתיקה), וחי ערמה של סיכוני רעידות אדמה בחלק מדרום־מזרח הירדנים לקראת חתימת חוזה חדש לייצור חשמל בעקבה, מדובר בכל הנראה בחוזה גת בוח בחיקף 1,000 מגאוט שתקים חברת אנ־רון. הסקרים נעשים בשיתוף רשות המחצבים הירדנית הלאומית (NRA).

מעילות המכון בירדן התאפשרה בעקבות תתיסת על מזכר לשיתוף פעולה בחקרי תת הקרקע שחתמו לאחרונה שתי המדינות.

בנוסף לפרויקטים אלה החל המכון הגיאופי־סי לישראל בביצוע פרויקט מיפוי משותף עם ירדן, במטרה לאחר את מפות הכבירה ומפות גרוויטציה של שתי המדינות באזורי הער־בה, ים המלח ונקעת הירדן. המעילות מסומנת על ידי משרד החוץ האמריקאי בשיתוף המכון הגיאולוגי האמריקאי.

מפות הכבירה משמשות לתעשיית חיפושי חנפט ולחיפושי מחצבים אחרים. איחוד המפות של שתי המדינות ישפר את דיוק הנתונים שב־ידי ישראל וירדן מכל הנוגע למבנה תת הקרקע באזורי הגבול.

יצוין כי זו פעם ראשונה שמתקיים שיתוף פעולה גלוי עם מדינה ערבית בתחום המחקרים הגיאופיסיים.

עוד נמסר כי המכון הגיאופיסי מבצע מחקר רים עבור מע"צ באזור צפת, המאופיין ברמת סיכון סיסמית גבוהה להיפגע מרעידות אדמה.

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המידע נאסף ע"פ הזמנה ולשימוש הבלעדי של: [illegible]

(א-94177 - [illegible])

העשיות
(423) דו-שבועון
13.07.97 יום א'

המכון הגיאופיסי ישתף פעולה עם רשות המחצבים של ירדן

המכון הגיאופיסי של ישראל יבצע סקרים גיאופיסיים בשיטות בלתי הרסניות בעקבה, בשיתוף עם רשות המחצבים הלאומית של ירדן (NRA).

לסקרים גיאופיסיים אלה, שתי מטרות עיקריות. אחת מיפוי אתר ארכיאולוגי בעיר עקבה (אילת העתיקה), כשלב מקדים לקראת הפירות המתוכננות באתר, ומיפוי מבנה תכונות תת הקרקע במסגרת הערכת סיכוני רעידות אדמה, כחלק מהערכות הירדנים להקים באזור עקבה תחנת כח חשמלית.

פעילות המכון הגיאופיסי לישראל בירדן, המתאפשרת בעקבות חתימה על מזכר שיתוף פעולה בין המדינות בתחומי פעילות אלה. בנוסף, החל לאחרונה פרוייקט משותף שמטרתו לאחד את מפות שדה הכבידה של ירדן וישראל באזורי הערכה, ים המלח ובקעת הירדן. פעילות זו ממומנת על ידי משרד החוץ של ארה"ב, ושותף לה גם המכון הגיאולוגי האמריקאי. איחוד מפות שדה הכבידה ישמש את מערכות חיפושי נפט בשתי המדינות ולחיפוש מחצבים אחרים בתת הקרקע. המחקר החדש ישפר את הנתונים אשר בידי המדינות על מבנה תת הקרקע באזור הגבול שביניהן.

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