AN ISRAELI, JORDANIAN AND PALESTINIAN GEOLOGICAL AND HYDROLOGICAL INFORMATION CENTER (G.I.C.) FOR THE LOWER JORDAN VALLEY AREA

Annat Yellin-Dror[1], Jacob Bensabat[2], Akiva Flexer[3], Nimrod Inbar[4], Marwan Haddad[5], Abdul-RahmanTamimi[6]

[1]Doctor of Geology and Geophysics, General Director of the G.I.C. The Department of Geophysics and Planetary Sciences, Tel Aviv University69978, Tel Aviv, Israel, annat@terra.tau.ac.il
[2]Doctor of Hydrology EWRE, Environmental & Water Resources Engineering Ltd., P.O.Box 6770, 3106, Hifa, Israel, jbensabat@ewre.com
[3]Professor of Geology, Head of the G.I.C. The Department of Geophysics and Planetary Sciences, Tel Aviv University 69978 Tel Aviv, Israel, akiva@terra.tau.ac.il
[4]Ph.D. Student in Geophysics and Hydrology
The Department of Geophysics and Planetary Sciences, Tel Aviv University 69978, Tel Aviv, Israel, nimr@post.tau.ac.il
[5]Prof. of Hydrological Engeeniring Al Najah University, Nablus, The West Bank, Palestinian Authority, haddad@najah.edu
[6]Dr. of Geology and Hydrlogy PHG, Palestinian Hydrological Group, Rammalla, The Palestinian Authority, phgtamimi@yahoo.com

ABSTRACT

An Israeli-Palestinian-Jordanian integrated Geohydrological Information Center (G.I.C.) and data processing was constructed. The G.I.C. integrates all the data available with respect to the Dead Sea area, the Jordan River Valley and its margins.

The objectives of the G.I.C. construction is to supply the core parties with the development of database to store, quality assure, analyze and exchange geological and hydrological information related to groundwater resources of the region. The G.I.C. conducted numerous activities to construct and improve the database for all core parties and to facilitate exchange of consistent and accurate data on regional water resources.

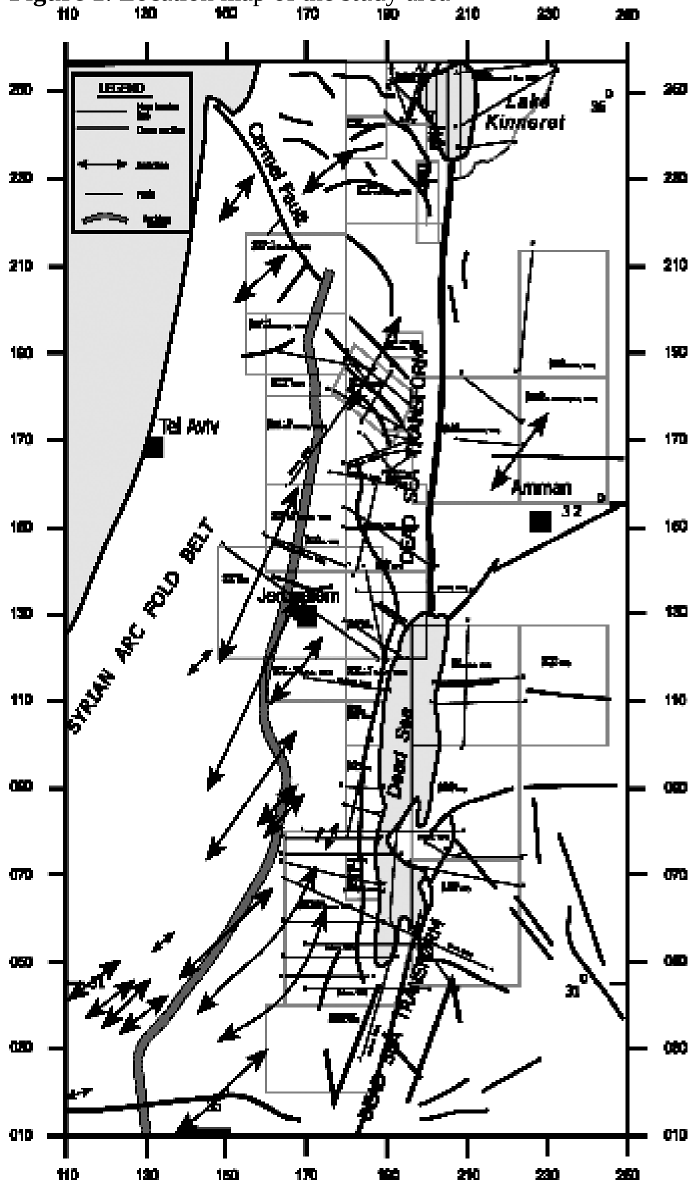
Improved capabilities to quantitatively analyze and use geohydrological data contribute to improve management of scarce and fragile groundwater resources in the region. Such regional G.I.C. can contribute not only to traditional geohydrological activities, such as well sitting, but also to advanced model of large-scale groundwater flow and transport. Advances in computer technology now allow realistic simulations of three-dimensional groundwater flow and simulation of flow and transport of saline waters beneath fresh rock aquifers. However, the accuracy of such models is largely based on the extent to which geohydrologic data, both quantitative and qualitative, is incorporated in the computer model input.

INTRODUCTION

The area of the Dead-Sea and the Jordan River is an arid natural front officially bordering between Israel, the Palestinian Authority and Jordan. However throughout the last century it has been an independent agriculture unit. Although the river itself carries only a trickle of water, together with the surrounding springs and seasoning floods, it supplies most of the Jordanian fresh water for agriculture and domestic use. The neighboring areas are the main agricultural districts of Jordan. On the Israeli and Palestinian side of the river the groundwater are used as one of the main fresh water resources for domestic and agricultural areas.

Because of the political situation and the hostility around the Dead-Sea and the Jordan River during the last century it was impossible to manage efficiently the water policy of the area. Now a day when peace has been achieved, to a certain extent, between Israel, the Palestinians and Jordan, it is in great need to provide a better management of the water policy on both sides of the river. For that cause an Israeli- Palestinian- Jordanian integrated Geo-hydrological Information Center (G.I.C.) and data processing center was constructed. The G.I.C. integrates all the data available with respect to the Dead-Sea area, the Jordan Valley and its margins (Fig 1).

Figure 1: Location map of the study area



OBJECTIVES

The objectives of the G.I.C. construction is to supply the core parties with the development of Geo-hydrological Information Center to store, quality assure, analyze and exchange geological and hydrological information related to groundwater resources of the region. The processing center applications has conducted numerous activities to construct, improve and facilitate the database with all data available from the region in order to allow all core parties the exchange of consistent and accurate data on regional water resources. Fig. 1 presents the location map of the study area with all data available including maps, seismic lines, major faults and folds.

METHODOLOGY AND RESULTS

The first step in the research program was focused on data collection. The integrated data collection was carried out for the research area. Research program for data collection was carried out in five major steps (Fig. 2):

1. Static data collection from oil and water wells: header information for each well including the following: well name, ID number, drilling company, geographic location, Xcoord, Ycoord, elevation, spaded and completed dates of drilling, total depth driller, total depth logger and last penetrated formation.
2. Geological data collection from oil and water wells: the data collected is mainly composite and stratigraphic logs, which includes lithological and stratigraphical description. The geological data available from oil wells in the study area is necessary to provide with the information on deep seated stratigraphy while geological data available from water wells in necessary in order to provide with high resolution geological information on shallow and upper stratigraphic levels. Data from water wells was selected according to the quality and amount of information available.
3. Geophysical data collection of all seismic lines available in the research area.
4. Technical data collection from oil and water wells: including technical information such as casing, pipes, hole diameter, screen location etc.
5. Hydrological data collection from water wells: all hydrological data that has been recorded and/or analyzed in the area was collected including: Cl level, NO3 level, Major ions, Water levels, pumpage, pumping tests.
6. Meteorological data collection: list of all rain station that are located within the study area was included in the database feeling in data of monthly averages for the active rain stations of the study area.

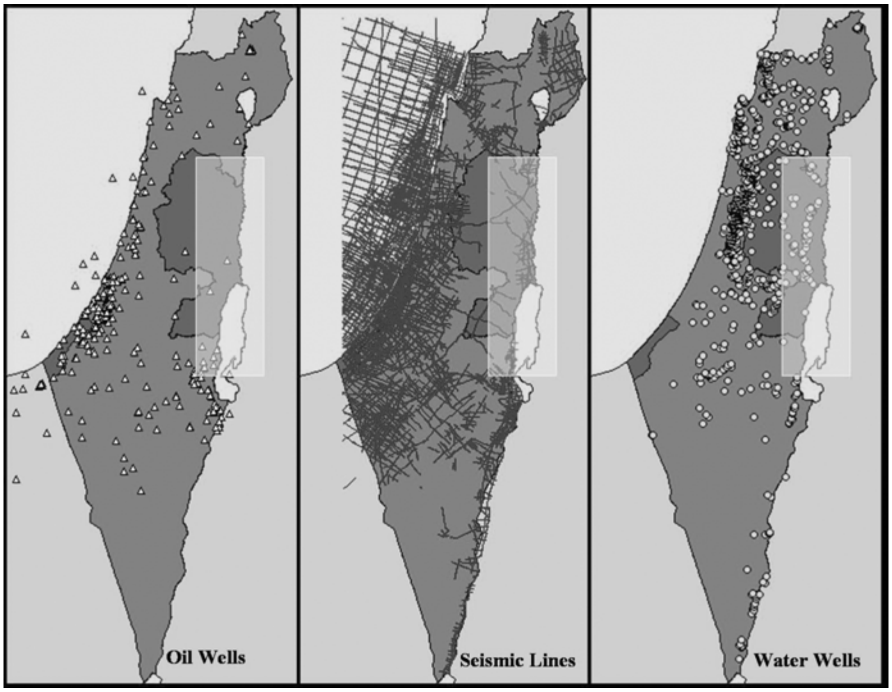


Figure 2: Location map of the study area with the integrated data collection of oil and water wells as well as seismic data.

Parallel to the data collection the current research group was also involved with the integrated data entry for all data collected in the study area. Data entry was divided into two major sets of information: a time dependent and a depth dependent. All hydrological data is considered time serious and all geological and technical information are considered depth serious.

The G.I.C. was programmed by 4 major steps:

1. The hydrological part of the project, which includes: data entry of the hydrological data in the windows ACCESS format and consistency checkup; preparation of the hydrological data layers; installation of the software applications.
2. The row geology part of the project which includes: presentation of geographic map (or any other map) with location of wells or any other data (see Fig. 2); constructing of geo-logical column for each well (Fig. 3); interactive construc-tion of geological cross-section cross-ing wells; the ability to save the inter-active cross-section information within the database; the ability to construct synthetic wells from the inter active cross-section and add it to the

data-base; constructing of 2D time (Cl, water levels, Nitrates, etc.) and depth dependent maps (isopach, str-uctural etc., Fig.4); exporting the row geology into simulation models.

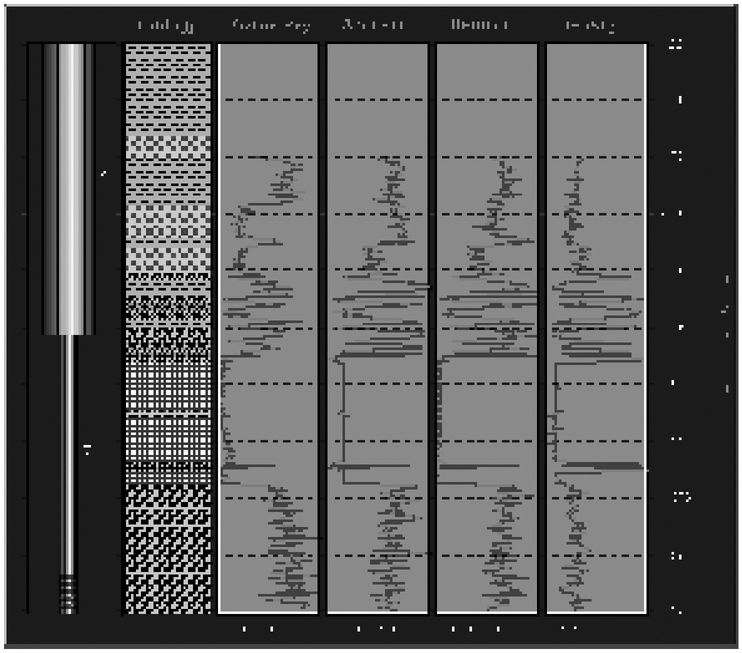


Figure 3: Graphic presentation of geological and technical well data as well as well logs.

3. The synthetic geology part of the project which includes: preparation of the mathema-tical tools to create regular net of points to define the geology according to the row data (Fig. 5). The computer-ized well file (Fig. 6) which includes presentation of well relevant data such as: the geological structure (age, stratigraphy and lith-ology); well header (ID, name, coor-dinates, type, TD, etc.); well technical parameters (pipe diameter, borehole diameter, screens etc.); options for presentation of activities within borehole during and after drilling (temperature, electric logs, pumping tests, etc.); presentation of data from the hydrological data layer (Cl, Nitrates, water levels, pumping, etc.).

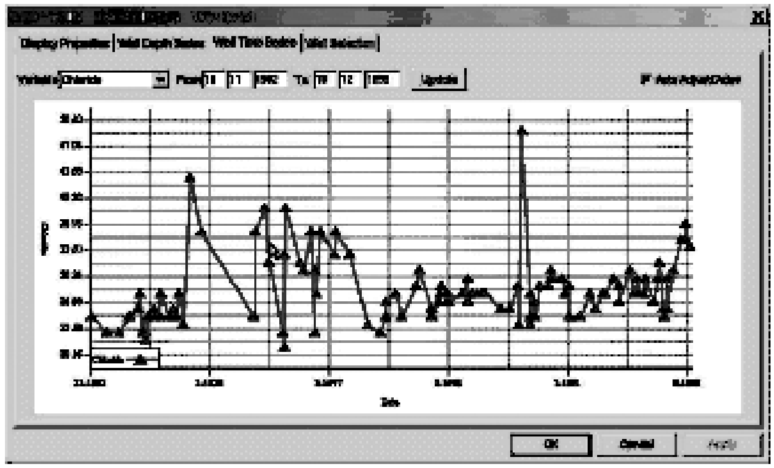


Figure 4: Graphic presentation of Hydrological data

The G.I.C. software allows the analysis, visualization and simulation of environmental data in its geographic setting. It has been primarily designed for projects of water resources management, groundwater pollution control, pollution remediation, risk analysis etc, but was extended to the needs of this specific project application that involves hydrological and geological data and geographic information. Natural resources management at large requires the collection, maintenance and analysis of large amounts of data, which are stored, and in various formats, such as spreadsheets, relational databases, text files, geographical maps etc. G.I.C. first assimilates this data and allows its analysis and visualization by means of an extensive library of tools.

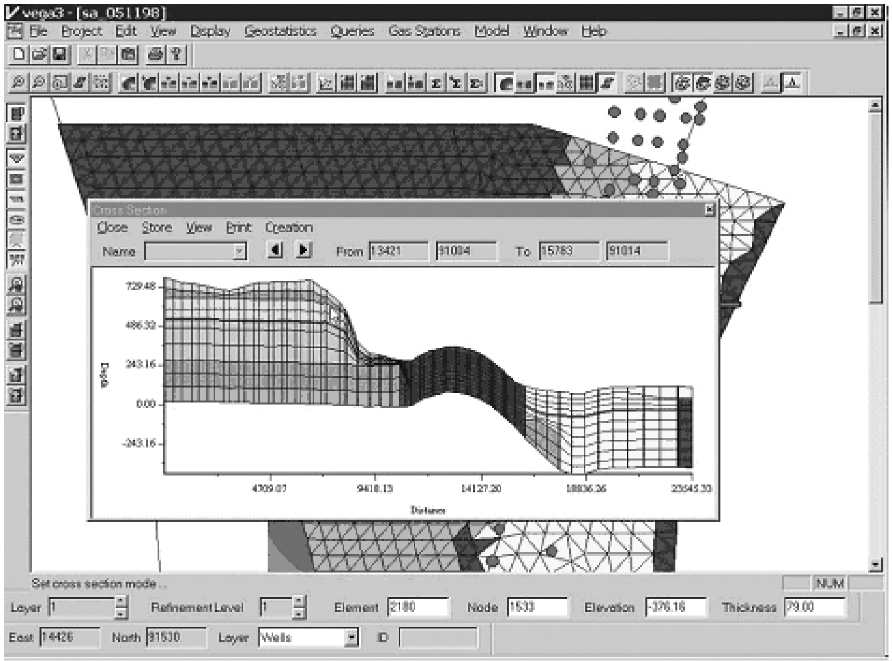


Figure 5: Graphic presentation of the synthetic geology

The main operations that can be performed within G.I.C. include: data assimilation; vector maps in various formats; raster maps in various formats; organization of the data into database layers; data processing; visual queries (selection of geographical areas on which queries are performed on any registered database layer; filtering on the basis on constraints on data; statistical queries); SQL statements; geostatistical tools (correlation analysis, statistical structure identification, inference, detrending of data, bias analysis, kriging, cokriging, kriging with constraints, disjunctive kriging, lognornal kriging, etc.); interpolation; Voronoi diagrams; generation of simulation models; mesh generation (2-D, 3-D); visual interface, automatic optimization of numbering, mesh quality analysis, mesh editing; definition of initial and boundary conditions, binding the database with the model; definition of simulation parameters using an interactive user friendly interface; visualization; location maps; 1-D and 2-D time series; 2-D contour maps, using either linear interpolation, non linear interpolation or kriging, on any data; geological fence Diagrams; geological cross-sections; contour maps on cross-sections.

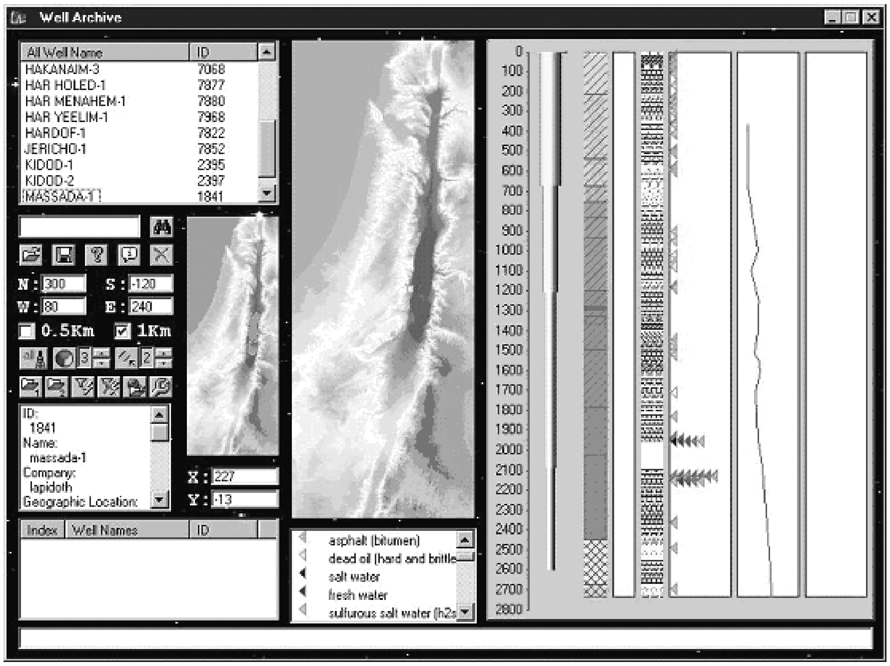


Figure 6: Graphic presentation of the computerized well file which includes presentation of well relevant data such as: the geological structure:age, stratigraphy and lithology; well header :ID, name, coordinates, type**,** total depth, etc.; well technical parameters: pipe diameter, borehole diameter, screens etc.; well logs.

DISCUSSION AND CONCLUSIONS

An integrated database environment was developed by the current research group in order to coordinate the overall geological, geochemical, geophysical and hydrological data of the area. The package was programmed to include all data, which has been recorded in the area in order to construct an integrated Geohydrological static/dynamically Information Center and data processing applications.

All of the core parties have participated in activities to enhance their abilities to exchange data that is collected using techniques that has undergone quality assurance and quality control procedure and that is digitally stored in a manner that permits exchange within and between institutions.

Among other successes, these efforts led to the cooperation of joint regional analyses of geological cross-sections, changes over time in groundwater levels, groundwater quality, springs discharge and stream flow.

Another class of water-resources data is geohydrologic data; that is, data about geological formations and rock type relating to groundwater. The data center contains a section on geology that highlights regional structure (map and cross section) and identifies water-bearing properties of various rock layers.

Improved capabilities to quantitatively analyze and use geohydrological data will contribute to improve management of scarce and fragile groundwater resources in the region. Such regional Information and data processing center can contribute not only to traditional geohydrological activities, such as well sitting, but also to advanced model of large-scale groundwater flow and transport. Advances in computer technology now allow realistic simulations of three-dimensional groundwater flow and simulation of flow and transport of saline waters beneath fresh rock aquifers. However, the accuracy of such models is largely based on the extent to which hydrogeologic data, both quantitative and qualitative, is incorporated in the computer model input.

ACKNOWLEDGEMENTS
The authors would like to express their thanks to the German Ministry of Education and Research (BMBF) and to the Israeli Ministry of Science (MOS) for supporting and funding the project: “Water Resources Evaluation for a Sustainable Development in the Jordan Rift Basin – German-Israeli-Palestinian-Jordanian Joint Research Program. Project Number 2WT 9179/1773.