Introduction

Geoarchaeology combines archaeological research with methods and concepts of the earth sciences (Butzer 1982). Geography (both physical and human), geology, geomorphology and geophysics have been melded with archaeology to develop a multidisciplinary approach for studying the site at Khirbet Qumran (hereafter Qumran) in Israel. The full range of earth (geo) sciences can be applied to archaeological evidence at the Qumran Archaeological Site allowing past processes and events to be inferred (Rapp and Hill 1998).

In the summers of 2001 and 2002, the multidisciplinary research team consisted of geographers, a geophysicist, a historian, a photographer, biblical scholars and archaeologists. This team of researchers attempted to expand the existing base of knowledge about Qumran.

Background

Qumran is along the western shore of the Dead Sea (Figure 1). This site is most famous for the caves, located in the cliffs west of the site, where the Dead Sea Scrolls were discovered. In 1947, Arab shepherds stumbled upon a cave and what they found was hailed as the greatest archaeological discovery of the twentieth century (VanderKam 1994). Eleven caves at Qumran have yielded the remains of approximately 800 manuscripts. Data compiled by Roland de Vaux (1973), based on detailed excavations from 1953 to 1956, make it clear that Qumran was occupied by a group engaged in communal activities and religious rites for most of its active history (Schiffman 1995). In an attempt to understand the historical context of the Dead Sea Scrolls, scholars have tried to identify the group responsible for these documents (VanderKam and Flint 2002). Schiffman (1995) accepted the conclusion, expressed by many biblical scholars, that the Qumran Sect was intrinsically linked to the scrolls found in the caves. The most widely adopted view is that the Qumran Sect was a small branch of the larger Essene movement (Sukenik 1955; VanderKam and Flint 2002). Scholars believe that this sectarian group was responsible for gathering together, copying (mostly between 150 B.C.E and 68 C.E.), and depositing documents in area caves. After modern discovery, these documents were called the Dead Sea Scrolls (Schiffman 1995).

A large cemetery just east of the archaeological site and smaller cemeteries to the north and south (Figure 2) are important parts of the complex (VanderKam 1994). The Main Cemetery begins approximately 50 meters from the east wall of the ruins at Qumran (de Vaux 1973; VanderKam and Flint 2002). The North Cemetery is approximately 50 meters north-northeast from the Main Cemetery and the South Cemetery is about 250 meters to the south-southwest. The South Cemetery is situated on a hill on the other side of Wadi Qumran. Between 1953 and 1956, de Vaux excavated 37 of the estimated 1,100 tombs in the Main Cemetery, two out of twelve in the North Cemetery, and four out of 30 in the South Cemetery. De Vaux estimated there were a total of 1,142 graves in the three cemeteries at Qumran. In 1966 and 1967, journalist S.H. Steckoll, with permission from the Jordanian Department of Antiquities (Qumran was in Jordan prior to the 1967 war), excavated nine graves in the Main Cemetery. Overall, a total of 52 graves were legally excavated at Qumran.

Nine early reports, dating back as far as 1850, described various aspects of the Qumran Site, but no one had subjected the ruins to a thorough examination until after the discovery of scroll material in Cave One in early 1947 (VanderKam and Flint 2002). The first scholars did not begin to work at Qumran until February, 1949 because of political instability and hostilities. The excavation at Cave One in 1949 was directed by de Vaux and G. Lankester Harding. During this excavation, they also visited the ruins of Qumran and conducted a quick surface examination. They returned...
Figure 2: The Qumran Archaeological Site, cemeteries, aqueduct, caves, and suspected latrine site.
in late 1951 and began to excavate portions of the surface ruins and cemetery. In 1953, de Vaux and Harding returned to work in newly found caves and at the surface ruins and cemetery; additional expeditions were staged in 1954, 1955, and 1956. After the final de Vaux-Harding expedition in 1956, little work was done with the archaeological remains at Qumran until the mid-1980s. In 1995-96, Magen Broshi and Hanan Eshel conducted a six-week season of excavation in an area of collapsed caves just north of Qumran. This was the last organized research effort at Qumran, until our research team began work at the site in July 2001.

The John and Carol Merrill Qumran Excavations Project

A major objective of the 2001 and 2002 Merrill excavations at Qumran was to create detailed maps of the cemeteries and maps depicting the spatial relationships between the cemeteries, ruin site, caves, and aqueduct system. Based upon information collected by de Vaux, our survey designated (1) the Main Cemetery, (2) the fingers of the Main Cemetery, (3) the North Cemetery, and (4) the South Cemetery. Additionally, a new cemetery was discovered during the 2002 survey, designated as the Highland Cemetery. Grave location data were collected in these cemeteries, as well as data related to grave orientation, grave condition, and the presence of headstones and footstones.

The graves in these cemeteries are marked by oval-shaped piles of stones, often with a larger stone at either end to serve as a headstone or footstone (Figure 3). Graves were classified as being in excellent condition (between 90% and 100% intact), good (60% to 90%), fair (30% to 60%), poor (10% to 30%) and very poor (< 10% intact). A wider view of the Main Cemetery (Figure 4) shows graves exhibiting various conditions of preservation. The Main Cemetery covers a flat plateau east of the Qumran ruins; additional graves are on three flat projections of land (fingers) extending eastward from the Main Cemetery and approximately 5 meters lower in elevation (Figure 5). These fingers are actively undergoing erosion and are separated from one another by gullies eroded by the occasional winter precipitation events (Figure 6). It is very likely that erosion has destroyed graves located along the margins of the fingers.

Accurate maps of the Qumran cemeteries are pivotal in understanding the archaeological evidence collected thus far at Qumran (Schiffman 1995). These detailed maps will allow the spatial aspects of the databases developed for Qumran to be assessed, compared and contrasted. Past mapping efforts by de Vaux and others did not produce a complete, accurate depiction. Our project collected field survey data using a total station surveying instrument and prism. Most graves were located visually, but additional graves, or what we suspect are graves, were located using ground penetrating radar (GPR). Location and elevation data were collected for each grave using the total station, then entered into spread sheets and transferred to a
Figure 5: Spatial and topographic relationships between the Qumran Archaeological Site, the main cemetery, the fingers, the North Cemetery, and the park visitor's center.
The 2001 and 2002 surveys found 1,056 graves with surface expression in the Main Cemetery, the three fingers, and the North Cemetery (978 were located visually). Seventy-eight of these graves had been previously excavated. Since de Vaux and Steckoll are credited with legally excavating a total of 46 graves in these cemeteries, it can be assumed that the other 32 are the result of illegal excavations. If the South and Highland cemeteries are included, four additional excavated graves (for a total of 82) and 17 additional visual graves (for a total of 995) are added, producing a total of 1,077 graves in all of the cemeteries that have some visual expression.

A total of 122 GPR anomalies were found as part of the survey of the Main Cemetery, fingers, and North Cemetery. These anomalies are suspected to be graves with no surface expression. Fourteen GPR anomalies were found in the South and Highland cemeteries. The total number of graves in all the cemeteries at Qumran, including suspected graves found using GPR, is 1,213. Of the 995 graves located visually in all the cemeteries (not including excavated graves), 14 (1.4%) were in excellent condition, 164 (16.5%) were in good condition, 424 (42.6%) were fair, 301 (30.3%) were poor, and 92 (9.2%) were in very poor condition. Our analysis indicates that a total of 129 graves, if all of the cemeteries are considered, possess headstones (13%), 103 graves have footstones (10.4%) and 30 graves have both head and footstones (3%).

In the upper part of the Main Cemetery the graves tend to be ordered in consistent rows and are oriented north-south, while on the fingers the positioning of the graves is far less regular and orientation is not constant (de Vaux 1973). This is especially true on the South Finger. Of the 978 graves that were located visually during our 2001 survey, 44 were oriented in directions other than north-south, with the most prominent secondary orientation being east-west. Most of the unusual orientations were found on the fingers, with the South Finger having 35, the Middle Finger six, and the North Finger two. The North Cemetery had one visual grave not oriented north-south. Excavations by de Vaux revealed that 27 of the 28 graves he excavated in the upper part of the Main Cemetery contained male remains. All of these graves were oriented north-south. The head of the skeletal remains he unearthed are oriented toward the south. Excavations of graves on the fingers and in the North and South cemeteries contained the remains of women and children, as well as males.

All of these graves, despite their differences, were of the same type, and appeared to be connected with the principal occupation of Qumran (VanderKam and Flint 2002). There is ongoing debate about who occupied Qumran and are buried in its cemeteries, but scholars generally agree that there is a connection with the Essenes, one of the three ancient Jewish groups named and described by the historian Josephus (VanderKam 1994; VanderKam and Flint 2002; Schiffman 1995; de Vaux 1973).

Two graves located on the Middle Finger of the east extension of the Main Cemetery have taken on a special significance. In 2002, a skeleton was discovered in a grave that has been designated Tomb 1000, the same site where the remains of two women from the first century AD were found during the summer of 2001. The skeleton discovered in 2002 was 1.5 meters below the surface, and approximately 1.0 meter below the remains of the two women, in an elaborate burial chamber situated in a prominent elevated position. The position of this burial chamber may indicate that a person of some importance was buried at the far eastern edge of the main cemetery (Figure 7).
A ceramic dated to the first century C.E. was found alongside the skeleton (Jacobson 2002). The skeleton was found facing east and the first rays of the rising sun would strike the burial chamber. This burial chamber is one of the most elaborate in a very simple place (Jacobson 2002). The east-west orientation is generally thought to coincide with Muslim burials that have taken place in the cemetery over the last several hundred years, but the presence of the first century pot confuses this issue. Scholars generally agree that the other east-west burials in the cemeteries are either Christian or Muslim (Bedouin) dating to the last few centuries (Zias 2000; Eshel et al. 2002), but the Tomb 1000 burial remains a mystery.

Grave 978 contains the remains of a zinc coffin. This grave was likely excavated by looters, and portions of the zinc coffin were damaged or removed. Grave 978 is oriented north-south, which is interpreted as a burial from the era of the Qumran Sect (Schiffman 1995; VanderKam 2002). The zinc coffin may have been used to transport a body from another location for burial at Qumran.

A Noggin GPR system mounted on a cart for increased mobility was used to explore the cemeteries at Qumran (Figure 8). The system emits energy waves into the ground and then collects these waves as they reflect back from the underlying geologic materials. In a known cemetery, GPR can look for locations where the materials had been disturbed, indicating a grave location with no surface expression. GPR surveys in some parts of the cemetery indicated undisturbed flat-lying layers of geologic materials (Figure 9). Other places had obviously been disturbed (Figure 10);

the GPR plots for these locations indicated a V-shaped pattern indicative of a site that had been dug and then refilled with the same material. Suspected graves, located using GPR, were identified in all of the cemeteries at Qumran: 84 in the main cemetery, one in the Middle Finger, six in the South Finger, 22 in the North Cemetery, five in the South Cemetery, and 9 in the Highland Cemetery.

**Aqueduct System**

The sectarians that occupied Qumran spent a large amount of time engaging in activities associated with ritual purity. Ablutions (ceremonial washing) were required before communal meals, after relieving oneself, and after meeting a non-member or novice (Schiffman 1995). Among the most striking features at the Qumran ruins are the cisterns and baths at the site. A growing population made it necessary to provide a plentiful and constant supply of water for the settlement, so an aqueduct was constructed to carry water provided by winter rains (de Vaux 1973). A narrow canyon extends from the mountains west of the Qumran Site, connecting with the upper reaches of Wadi Qumran. Structures were created in the lower portions of the canyon to move water toward the site, rather then down the wadi and into the Dead Sea. At some points the
The aqueduct was cut into the rock, but in other places the water flowed through a series of tunnels excavated through solid rock. Once out of the rocky canyon, the aqueduct was dug into the marl terrace that slants toward the settlement (Schultz 1960). Upon reaching the settlement, the channel was coated with plaster and for some part of its winding course between buildings it was covered with stone slabs (de Vaux 1973). The difficult and elaborate construction of the aqueduct is a testimonial to the importance of water to the Qumran Sect.

Mapping of the aqueduct system was completed in the summer of 2002 using a hand-held optical compass, inclinometer, and survey tape. A 270 meter section of the aqueduct, extending from the base of the cliffs west of the Qumran Site has been restored by the Israel Antiquities Authority (Figure 11). Sections of the aqueduct were destroyed by two slumps, but a 15 meter section between the two slumps remains intact (Figures 12). A well-preserved section of the aqueduct extends from the small slump before the channel diverges. A lower section of the aqueduct has collapsed, but higher up the slope the aqueduct was routed through two tunnels. We speculate that these tunnels were created as a more stable route for the aqueduct after the lower route was destroyed by collapse. Further up the canyon, a small stone dam was constructed and a narrow channel was cut to direct the runoff from the winter rains into the Qumran aqueduct system.

Two GPR grids were established in order to survey an area suspected to be the latrine for the settlement. The Qumran Sect, guided by laws of ritual purity, located the latrines away from the main communal areas of the site. The GPR survey did show anomalies at these locations, but it is too early in the investigation to draw conclusions.

An Electrical Resistivity Tomography (ERT) survey was completed in and around the Qumran site by Paul Bauman from Komex International. This geophysical technique can detect cavities in the subsurface that have no surface expression. The subsurface region was sampled by transmitting energy between two adjacent electrodes, and from the properties of these transmissions, a cross-sectional image of the region was constructed.
The previously discovered caves that contained scroll material are in areas of rugged, exposed limestone cliffs, with many of the caves adjacent to the Qumran Site (Caves 4, 5, 6, 7, 8, 9 and 10 [see Figure 2]) and others (Caves 1, 2, 3, and 11) up to 1,775 meters away. This limestone topography is very common in and around Qumran, so we assumed that there might be collapsed caves containing artifacts. The ERT survey was completed to pinpoint possible locations for excavation. Several such locations were established and these areas were probed with an auger (a portable hand-held drilling device), but no cavities were found. We plan to continue research on a future expedition to Qumran.

Summary and Conclusions

The spatial distribution of the site components indicates a pattern of usage consistent with interpretations made by Schiffman (1995), Sukenik (1955), and VanderKam and Flint (2002) that the Qumran Sect were intrinsically linked to the scrolls found in the caves. The Qumran Sect also was linked to the cemeteries adjacent to the site. Tomb 1000 is where they buried a person of local and perhaps even regional importance. Despite differences in the pattern and orientation of some of the graves in the Main and North cemeteries, the graves appear to be connected with the principal occupation of Qumran (VanderKam and Flint 2002). The location of the Highland and South cemeteries on the south side of Wadi Qumran, physically separated from the site, may indicate that these burials are not directly associated with the Qumran Sect. Only one of twelve non-excavated graves with visual expression in the South Cemetery is oriented north-south, with the others oriented east-west (seven) or northeast-southwest (four). In the Highland Cemetery, all four graves with visual expression are oriented northeast-southwest. The graves in the South and Highland cemeteries have been interpreted as Bedouin (Zias 2000; Eshel et al. 2002), because of the topographic separation from the main cemeteries and the lack of north-south graves. The graves in the Highland Cemetery were a new discovery and had not been previously mentioned in the Qumran literature.

Another new discovery was made at the site in December 2002. Based on the results of a GPR survey, Dr. Yitzhak Magen from the Israel Antiquities Authority conducted an excavation in the area outside the east wall of the Qumran settlement. He discovered a series of buried jars, but it will take years to fully understand the intricacies of this discovery. This new information will eventually help us piece together another part of the Qumran story and may provide more insight into the use of cemeteries (Freund 2002).

The 2001 and 2002 John and Carol Merrill Qumran Excavations Projects have increased our knowledge about the Qumran Archaeological Site. Complete and accurate maps of the cemeteries now exist. A detailed map of the aqueduct system has been completed, along with a detailed map showing the spatial relationships between the components of Qumran's cultural landscape. Ground penetrating radar technology indicated the possible locations of burials that have no surface expression, and pinpointed a location where eight buried jars were discovered. GPR also indicated an area of disturbance that may be the location of the latrines for the city. Electrical resistivity tomography discovered new cavities beneath the Qumran site and provided important information about the nature of the subsurface geologic materials in the area. Working within the multidisciplinary framework of geoarchaeology, we were able to apply various aspects of the geosciences to interpret past processes and events at Qumran, providing new insights into Qumran's physical and cultural landscapes.

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References


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