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Appendix A: GIS procedures

This study has used various digital methods to store, model and analyse geographic information. This was carried out in a geographic information system (GIS). The GIS used in this study is ArcGIS, version 10.2, produced by Esri company. All imagery and geographic data was stored and displayed in the WGS 84 coordinate system and Universal Transverse Mercator projection.

Georeferencing and orthorectification

Georeferencing refers to relating coordinates from maps, aerial photographs and imagery to coordinates on the ground, in order to accurately store and project the imagery. Georeferencing is required when such coordinates are not incorporated in the digital imagery files, for example when it includes scanned files of hardcopy maps of photographs. For this study, scans of topographic maps and geological maps, Corona imagery, and aerial photographs were processed this way using the 'Georeferencing' tool in ArcGIS. This tool is also to orthorectify georeferenced raster data. Orthorectification entails creating a geometrically correct projection of the raster. This is required when, for example, oblique aerial photographs are stored in the GIS, in which case the scale differs (i.e., the foreground has a smaller scale than the background). In this case the imagery needs to be warped to create an equal scale over the entire raster. In some cases a DEM was used to further reduce image distortions that result from topographic variations.

Surface Cover Classification based on Landsat 8 imagery following a supervised classification procedure (Chapter 2, Fig. 2.16)

Image classification entails the classification of cell values of a raster dataset in a number of classes. In a supervised classification these classes are predefined by 'teaching' ArcGIS cell values that should represent different classes. This is done by manually creating signatures. In the case of a surface cover classification different types of surface cover are given a different signature. These signatures are then used in ArcGIS to classify the image.

The following procedure was used to create a classification in terms of surface cover:

1. Image selection: Landsat 8 imagery with no 0% cloud cover and as little water as possible. The selected image for this purpose was LC81730382013194LGN00, taken on July 13 2013.
2. Create a composite raster of bands 7, 6 and 5 (following Leverington & Moon 2012) in RGB, using the ArcGIS 'Image Analysis' toolbar.
3. Create of a polygon shapefile to define signatures.
4. Manually draw polygons over areas for which the surface cover was known, based either on geological maps or on Ikonos satellite imagery. 13 classes were defined:
    1. Basalt (Qurma formation)
    2. Chert (Umm Rijam formation)
    3. Mudflat
    4. Limestone/sandstone
    5. Agriculture
    6. Desert pavement
    7. Alluvial gravel
    8. Sand
    9. Basalt (Wisad formation)
    10. Chalk (Wadi Shalalah formation)
    11. Water
    12. Alluvial chert gravel
    13. Basalt & sand
5. Create Signatures for the areas indicated through the signature polygons using the 'Create Signatures' tool
6. Classify the Landsat imagery (Bands 7-6-5) based on the created signature file using the 'Maximum Likelihood Classification' tool.

Hillslope Position Classification of WorldDEM data (Chapter 2, Fig. 2.14)

Hillslope Position Classification (HPC) is a method developed by physical geographers Bradley Miller and Randall Schaetzl (Miller 2014; Miller & Schaetzl 2015) in which absolute elevations, slope degrees and slope curvatures are classified in order to create a model that differentiates between different topographic classes, being:

1. Summits (or other topographic highs)
2. Shoulders (or ridges)
3. Backslopes (or steep slopes)
4. Footslopes (or modest slopes)
5. Toeslopes (or topographic lows)

A Toolbox that can be used in ArcGIS was developed by Miller for creating a Hillslope Position Classification. This 'Relief Analysis' toolbox was downloaded from http://www.geographer-miller.com/relief-analysis-toolbox/.

The following procedure was used to create a HPC of WorldDEM data, using the 'Relief Analysis' toolbox:

1. Project the WorldDEM raster to UTM_Zone_37N using the 'Project Raster' tool, with a bilinear resampling method.
2. Create a slope degree raster based on the projected WorldDEM using the 'Slope' tool.
3. Classify the slope degree raster using the '3 Class by Breaks' tool of the Relief Analysis toolbox. Three classes were defined:
    1. < 5 degrees ('flat' areas)
    2. > 5 < 15 degrees (modest slopes)
    3. > 15 degrees (steep slopes)
4. Create a curvature raster based on the projected WorldDEM using the 'Curvature' tool.
5. Classify the curvature raster using the '2 Class by Breaks' tool of the Relief Analysis toolbox. Two classes were defined:
    1. < 0.5 ((near-)linear or concave areas)
    2. > 0.5 (convex areas; i.e. shoulders)
6. Clean up the classified curvature raster using the 'Majority' tool three consecutive times. Residual pixels are thus cleared from the raster.
7. Calculate the relative elevation of areas (topographic highs and lows) using the 'Relative elevation' tool of the Relief Analysis toolbox, using a Neighborhood setting of 500 m on the map.
8. Classify the relative elevation raster using the '2 Class by Breaks' tool of the Relief Analysis toolbox.
9. Create a HPC raster based on the three classified rasters (slope degree, curvature and relative elevation) using the 'Manual classification Method' tool of the Relief Analysis toolbox. The resulting raster has five classes:
    1. Topographic highs : high regions relative to their immediate surrounding, with less than 5° of slope
    2. Ridges: areas with a very convex slope curvature, i.e., > 0.5
    3. Steep slopes: areas with a slope degree higher than 15°
    4. Modest slopes: areas with a slope degree between 5° and 15°
    5. Topographic lows: low regions relative to their immediate surrounding, with less than 5° of slope
10. Clip the Hillslope Position Classification raster to remove erroneous cells resulting from edge effects.

Modelling of drainage systems based on WorldDEM data (Chapter 2, Fig. 2.23)

For landscape models related to the drainage networks of the study area, including wadi courses, major drainage basins, as well as tributary drainage basins (or small valleys) and closed (or endorheic) basins, WorldDEM data was used. The Hydrology toolbox in ArcGIS allows for the reconstruction of the direction and accumulation of water flows. However, endorheic basins are not modelled correctly by these tools, as the 'Flow Accumulation' tool forces endorheic basins to 'spill out' into adjacent drainage basins rather than to drain internally. Therefore endorheic basins had to be defined manually to some extent before they could be incorporated into a model (see below).

The following procedure was used to create these models:

1. Project the WorldDEM raster to UTM_Zone_37N using the 'Project Raster' tool, using a bilinear resampling method.
2. Ensure hydrological consistency of the projected WorldDEM raster using the 'Fill' tool.
3. Create a direction of flow raster based on the projected and filled WorldDEM raster using the 'Flow Direction' tool.
4. Create a model of wadi courses based on the Flow Direction raster using the 'Flow Accumulation' tool.
5. Model major drainage basins in a raster based on the Flow Direction raster using the 'Basin' tool.
6. Create manually defined pour points in a point shapefile to define tributary valleys and endorheic basins. Tributary valleys were defined through visual inspection of the WorldDEM raster, while endorheic basins were defined through visual inspection of mudflats on Ikonos imagery.
7. Model tributary valleys and endorheic basins in a raster based on Flow Direction and the manually defined poor points using the 'Watershed' tool.
8. Convert the raster delineating valleys and basins into polygons using the 'Raster to Polygon' tool.

Cost Surface raster classification based on WorldDEM data and Surface Cover Classification (Chapter 2, Fig. 2.21)

In a cost surface raster the relative costs of movement through a landscape are modelled based on parameters influencing cost of movement, which in this case were slope degree and surface cover. For this model WorldDEM data and the surface cover classification based on Landsat 8 (see above) were used.

The following procedure was used to create a cost surface raster:
1. Project the WorldDEM raster to UTM_Zone_37N using the 'Project Raster' tool, using a bilinear resampling method.
2. Create a slope degree raster using the 'Slope' tool.
3. Classify the slope degree raster into 10 classes using the 'Reclassify' tool, using a quantile classification method.
4. Create a cost surface raster based on the classified slope degree raster and the classified surface cover raster using the 'Weighted Overlay' tool, setting the influence of both rasters to 50%. The 13 classes of the surface cover raster were divided over a 1 to 10 scale (1 = lowest cost; 10 = highest cost) as follows:

1. Basalt 8
2. Chert 3
3. Mudflat 1
4. Limestone/sandstone 3
5. Agriculture /
6. Desert pavement 3
7. Alluvial gravel 5
8. Sand 10
9. Wisad basalt 8
10. Chalk 3
11. Water 10
12. Alluvial chert gravel 3
13. Basalt & sand 10

Cumulative viewshed analysis for Visual Prominence Classification (Chapter 2, Fig. 2.26)

In a viewshed analysis the visible and non-visible cells of a DEM from a number of observer points are calculated. In the resulting raster, the value of each cell shows from how many observer points the cell is visible. In a cumulative viewshed analysis the outcomes of multiple viewshed analyses are combined in a single raster dataset. In the resulting raster, the value of each cell is the sum of the raster values of the separate viewshed analyses.

A cumulative viewshed analyses can be used to visualize locations in the landscape that are more prominent than others, by creating viewsheds of a number of randomly created observer points within a DEM and creating a cumulative viewshed from the resulting rasters (Bourgeois 2013; O'Driscoll 2017). The resulting raster may

then be classified into a Visual Prominence Classification (VPC) raster, showing areas with different degrees of visual prominence.

For the VPC of the Jebel Qurma region 10 viewsheds were created on the basis of 10 sets of randomly created points within the extent of the WorldDEM dataset. This DEM was also used for the viewshed analyses. The resulting rasters were combined to create a cumulative viewshed, which was subsequently classified into five classes indicating the degree of visual prominence.

The following procedure was used to create the VPC raster:
1. Create ten sets of random points on the WorldDEM data extent using the ArcGIS 'Create Random Points' tool. Each set contained 100 points with a minimal spacing of 250 m.
2. Create ten viewshed rasters of the ten randomly created collections of observer points, using the WorldDEM as surface, with the ArcGIS 'Visibility' tool. A surface offset of 1.5 m was used, and an observer offset of 1.7 m. 'Frequency' was used as the analysis type, so that each resulting cell contained a value indicating the number of observer points to which the cell was visible.
3. Create a cumulative viewshed raster by combining the ten viewsheds, using the ArcGIS 'Raster Calculator' tool.
4. Classify the resulting raster into 5 classes using a Jenks classification method. These classes were labelled as follows to indicate the degree of visual prominence: 1) Very low; 2) Low; 3) Medium; 4) High; 5) Very high.

Skyline analysis of WorldDEM data (Chapter 2, Fig. 2.27)
The WorldDEM dataset was used to determine dominant skylines in the Jebel Qurma region, i.e., ridgelines of prominent hills cresting the horizon of observers is low-lying areas. This was done by performing a skyline analysis in ArcGIS. This analysis determines which elements of the landscape are visible along the horizon from a number of observer points. These observer points were placed in areas that were defined as topographic lows in the HPC, as described above.

The following procedure was used:
1. Create a total of 60 observer points by manually placing these within areas defined as 'topographic lows' in the HPC.
2. Convert these observer points into 3D features, i.e., containing z-values required for the skyline analysis. The ArcGIS 'Extract Values to Points' tool was used here, extracting the z-values from the WorldDEM cells to the corresponding point features. Added to these z-values was a value of 1.7 m, representing the estimated height of an average observer. The ArcGIS 'Feature to 3D by Attributes' tool was subsequently used to create 3D features based on the extracted z-values.
3. Create skylines using the ArcGIS 'Skyline' tool, using the default settings, without any surface constraints. The 60 3D observer points were used and the WorldDEM raster as surface dataset. The results are a total of 60 polylines each representing the skyline of an individual observer point.
4. Create points from the resulting vertices. The ArcGIS 'Feature Vertices to Points' tool was used to convert the skyline polylines into points, with each point representing a spot on the horizon visible from an observer point.
5. Remove points along the edges of the WorldDEM raster. False points were present on the edges of the WorldDEM raster as a result of edge effects. These points were manually removed.
6. Define skylines in the landscape. The ArcGIS 'Kernel Density' tool was used to calculate the density of points with a search radius of 50 m around each point along each of the 60 skylines. The densities were classified using Jenks classification, resulting in a raster that highlights the dominant skylines in the study area.

Appendix B: Description of find contexts of consulted ceramic parallels

For this study a variety of published pottery corpora were consulted for the purpose of dating ceramics from the Jebel Qurma region on typological grounds (see § 3.4.1.). Care was taken in using reliable sources, i.e., materials from secure stratigraphic and well-dated contexts. Presented below are descriptions of these contexts, ordered chronologically.

Late Iron Age II period (539 - 332 BC)

Tell Balata, Stratum V, Field VII (Lapp 2008, Pl. 2.10:4). This context represents a fill sealed by a Hellenistic surface. The stratum was dated between 525-475 BC, based on limited numismatic evidence and imported Attic wares.

Hellenistic period (332 BC – AD 106)

Pella, Area XIII: the Jebel Sarbata fortress (McNicoll et al. 1982, Pl. 127). Although the precise contexts of the ceramics are not reported, the entire corpus was dated on typological grounds to the Hellenistic period.

Beth She'an (Scythopolis), the *tell*, Area P, Stratum P-5 (Johnson 2006, Fig. 51.1-51.5). These ceramics are from a well stratified domestic context that was dated on the basis of imported fine ware types and numismatic evidence between the 3rd and 1st centuries BC.

Tell Anafa, Stratum HEL1A (Berlin 1997, Pl. 57:PW80). This is a stratified context sealed by the Stuccoed Building of the Late Hellenistic period. The date of this stratum was further established through coins.

Late Hellenistic period (100 BC – AD 106)

Tell Anafa, Stratum ROM1A (Berlin 1997, Pl. 68:PW536). This stratum is associated with buildings 1 to 5, and was dated between the late 1st century BC to the early 1st century AD on the basis of imported fine wares and coins.

Jericho, Stages 2 to 7 of the Hasmonean Palace complex (Bar-Nathan 2002, Pl. 11), Herod's Third Palace (Bar-Nathan 2002, Pl. 27), including circular room B68 (Bar-Nathan 2002, Pl. XI). These represent stratified remains dated on typological grounds between the 1st century BC and the first half of the 1st century AD.

Jerusalem, the National Convention Centre, ceramic phases 2-4 (Berlin 2005, Figs. 6 & 9). These are ceramics from stratified remains which were dated on typological grounds between the late 1st century BC to AD 70. However, it is not made explicit how the 'ceramic phases' relate to the stratigraphy at the site.

Jerusalem, the Jewish Quarter. Area A, strata 4 and 4a (Geva & Rosenthal-Heginbottom 2003, Pls. 6.9-6.10) are well stratified remains separated by floor levels. Numerous coin finds indicate an early 1st century AD date. Area E, stratum 2 (Geva & Herschkovitz 2006, Pl. 4.13) represents the fill of Pool L.742, dated between 1-70 AD on the basis of numismatic evidence and ceramic typology.

Masada, Zealot occupation levels in the Western Palace (Bar-Nathan 2006, Pl. 29:37-43; Pl. 32). These are remains from a number of floor contexts , dated on typological grounds to the third quarter of the 1st century AD.

Late-Hellenistic – Early Roman period (100 BC – AD 200)

Petra, ez-Zantur (Schmid 2000). The domestic complex yielded a large number of ceramics that were published in great detail. They represent a well-stratified corpus that could be dated on the basis of coins and imported fine wares.

Sepphoris, Western Summit (Balouka 2013, Pls. 8-12). These are well-stratified remains retrieved from the residential area. They were dated on typological grounds and through coins between 70-135 AD.

Early – Late Roman period (AD 106 – 324)

Sepphoris, Western Summit (Balouka 2013, Pls. 13-15, 17-27). These ceramics are from refuse layers in the cisterns, dated on the basis of ceramics, including well datable lamps, between 135-300 AD.

Umm al-Rasas (Kastron Mefa'a), Church of the Lions (Alliata 1992, Fig. 9:15-38). From the fill above the floor of an atrium to the west of the church came a number ceramics. Their typology indicated that the fill should be dated to the 3rd-4th century AD.

Late Roman – Byzantine period (AD 200 – 634)

Jerusalem, the Jewish Quarter, Area W, Stratum 2 (Magness 2003, Pl. 18.2:1-22). This stratum represents a fill between Byzantine wall remains. Although this fill was not sealed it contained a fairly homogeneous set of ceramics dated with coins and imported fine wares between the 4th and early 6th century AD.

El-Lejjun, Area P, the East Vicus Building (Parker 2006, Fig. 16.37). Soundings in several rooms of a building in the vicus at the Roman fort at al-Lejjun exposed a number of contexts that could be dated, on the basis of numismatic evidence, between 284 and 363 AD.

Madaba, Bajali courtyard. Stratum US12 (Acconci & Gabrieli 1994, Fig. 24) was situated outside a Byzantine house and yielded ceramics from the Late Roman and Byzantine period. The stratum could only be dated on relative terms, i.e. on typological and stratigraphic grounds. Stratum US10 (Acconci & Gabrieli 1994, Fig. 27) was situated in Cistern I and was dated, again on relative terms, between the 3rd and 5th centuries AD.

Sepphoris, Area 84 on the Western Summit (Balouka 2013, Pls. 28-32). Area 84 yielded well-stratified remains from the Late Roman and Byzantine period, some of which were sealed by earthquake destruction layers. Other dating evidence included coins, lamps, and imported fine wares.

Beth She'an (Scythopolis), the *tell*, Area P, Strata P-3 and P-4 (Johnson 2006, Fig. 15.6). Excavations on the shoulder of the *tell* yielded stratified remains that could be dated, on the basis of imported fine wares and amphorae, between the 4th and 6th centuries AD.

Early Byzantine period (AD 324 – 500)

'Amman (Philadelphia), Area C (Northedge 1992, Fig. 123). An abandonment context on a floor of a building was dated on typological grounds between the middle of the 4th to the early 5th centuries AD.

Early – Late Byzantine period (AD 324 – 634)

Caesarea Maritima, Stratum 5 (Bar-Nathan & Adato 1986, Figs. 1 & 2). These are fairly poorly stratified remains from a modestly exposed area, yet broadly datable on the basis of numismatic evidence between the 5th and 6th centuries AD.

Dhiban (Dibon), Areas S3 and S4 (Tushingham 1972, Figs. 9-12). These represent stratified remains from an open area outside the church complex wall. The strata were dated on the basis of imported fine wares and seriation with other excavated parts of the site.

Beth She'an (Scythopolis), the *tell*, Stratum H-2 in Area H (Johnson 2006, Fig. 15.13) and Stratum L-2 in Area 2 were both dated on typological grounds to the Byzantine period.

Pella, East Cemetery, Stratum IIA (Smith 1973, Pls. 43 & 44). These are remains from a small domestic structure, represented by ca. 10-20cm of occupational debris covering a plastered floor. This layer was dated to the Byzantine period on the basis of ceramic typology.

Late Byzantine period (AD 500 –634)

Caesarea Maritima, Area V/4 (Magness 1994, Fig. 1:16-17). These ceramics are from Locus 4061, a well-stratified context above the foundation trench of the Byzantine city wall. The corpus was dated on typological grounds between the 6th and early 7th century AD.

Pella, Area IX: The Civic Complex. Loci 77, 101 & 105 from the Baths (Smith & Day 1989, Pls. 52 & 53) are stratified remains that were dated on typological grounds to the 6th-early 7th century AD. Loci 44, 52 and 62 (Smith & Day 1989, Pls. 46-51) are refuse layers in the Classical Odeum that were also dated, in this case on the basis of numismatic evidence, to the 6th-early 7th century AD.

Late Byzantine – Umayyad period (AD 500 – 750)

Yoqne'am, Area E, Phase 3 (Avissar 1996, Fig. XII.7:5). This pottery came from mixed layers underneath the crusader period church, which were dated on the basis of imported fine wares between the 5th and 7th centuries AD.

Beth She'an (Baysan), the Pottery Workshop, fill of Kiln 4, Locus 50618 (Bar-Nathan 2011, Fig. 11.3:1, 11). These are well-stratified remains, dated by numismatic evidence to the 6th or 7th century AD.

Barsinia (El-Khouri 2014, Fig. 9). Little contextual information is available for this pottery corpus, and it seems it was dated solely on typological grounds.

Umm al-Rasas (Kastron Mefa'a), St. Stephen church complex, Room F (Alliata 1991, Fig. 18:1-14). This is a context sealed between a floor and a destruction layer. It was dated through many coin finds between the 6th and 8th centuries AD.

Jerash (Gerasa), kiln area, phases 2 and 3 (Ball et al. 1986, Fig. 3). The strata were dated on the basis of coin evidence and ceramic typology between the late 6th and early 8th centuries AD.

Jerash (Gerasa) Hippodrome, carceres area (Kehrberg 1989, Fig. 5). Late Byzantine and Umayyad remains came from a layer sealed by the tumble of the starting gates of the hippodrome, which was destroyed in AD 749.

Umayyad period (AD 634 – 750)

'Amman citadel (Olavarri-Goicoechea 1985). These represent well-stratified remains within the Umayyad palace. The stratum dates are based solely on ceramic typology.

Dhiban, North Church. Sherds from an abandonment phase of the church (Tushingham 1972, Fig. 6:1-10, 14-23) were dated on typological grounds to the Umayyad period. The sherds from debris in room A (Tushingham 1972, Fig. 7:1-20) were dated on the basis of a destruction event to the early 8th century AD.

Madaba, Bajali courtyard, Stratum US20 (Acconci & Gabrieli 1994, Fig. 46). These are well-stratified remains from the Umayyad period House H. The stratum was dated on the basis of ceramic typology.

Pella (Tabaqat Fahl). Remains between two destruction layers related to earthquake events dated to 717 and 746/747 AD were encountered in a number of areas in the Civic Complex (McNicoll et al. 1982, Pls. 140-141; Smith & Day 1989, Pls. 54, 55, 58, 59). Another context that was sealed by earthquake events came from the West Church Complex, Area I (Smith 1973, Pls. 30-33), and was dated between the mid-7th and the mid-8th century AD. This date is corroborated by numismatic evidence. Pottery sherds from the South Building, Area IB (McNicoll et al. 1982, Pls. 145 & 146) were found in a destruction layer related to a 746/747 AD earthquake, and is therefore said to represent early 8th century material.

Umm al-Jimal (Parker 1998, Figs. 155-157). This is well-stratified material from contexts within three buildings. The dates of the strata were based on ceramic typology.

Jerash, North Theatre, Phase 5 (Clark et al. 1986, Fig. 21). This phase represents the pottery workshop area at the Classical theatre, dated on typological grounds to the first half of the 8th century AD.

Beth She'an (Baysan), the Theatre Workshop. Pottery from various stratified contexts was retrieved from the pottery workshop. Locus 60669 (Bar-Nathan 2011, Fig. 11.13:3; Fig. 11.6:6) represents a latrine waste deposit dated on the basis of coins to the Umayyad period. Locus 50620 (Bar-Nathan 2011, Fig. 11.3:10) represents an early 8th century use phase of Kiln 2, sealed by a 749 AD earthquake destruction layer. Strata 7-5 in Unit 2 (Bar-Nathan 2011, Fig. 11.4:6) cover a destruction layer of a 659/660 AD earthquake, and were further dated with coins between the late 7th and early 8th centuries AD.

Humaymah, Lower Church, Room 5 ('Amr & Schick 2001, Fig. 9:20-21). These sherds are from a context that was covering a floor and was sealed by debris from a conflagration event. This sealed context was dated on typological grounds to the early 7th century AD.

Umayyad – Abbasid period (AD 634 – 969)

Tell Jawa, Building 600 (Daviau 2010, Figs. 8.7, 8.9, 8.10). This 'Early Islamic House' yielded rich and well-stratified pottery finds. The dates of the strata were largely based on numismatic evidence, and were mostly from the 8th century AD.

Beth She'an (Baysan), the *tell,* Area P, Stratum P-2 (Johnson 2006, Fig. 15.14). Part of an Early Islamic building was excavated here. Its date is based solely on ceramic typology.

Ramla, Area 82.1, Strata IV and V (Cytryn-Silverman 2010, Pl. 35:1-10). These are well-stratified ceramics associated with Umayyad period architecture that remained in use during the Abbasid period. The strata were dated on the basis of ceramic typology.

Abbasid period (AD 750 – 969)

Ramla, Square O-2 (Cytryn-Silverman 2010, Pl. 9.18). These sherds are from a fill above natural soil, sealed by a plaster floor that was dated to ca. 800 AD. The ceramic typology furthermore suggests a late 8th century date for this context.

Khirbat Yajuz, Area E (Khalil & Kareem 2002, Figs. 8-22). A late 8th to 10th century settlement phase was covering a destruction layer associated with a 749 AD earthquake event. This date of this phase is partially based on limited coin evidence.

Al-Muwaqqar palace, Area IV, square H14 (Najjar 1989, Figs. 5-8). An Abbasid occupation phase of the palace was exposed in this area, which was dated on the basis of glazed wares and lamps to the late 8th-early 9th century AD.

Other sources

A number of parallels were found in a typo-chronological study by Kuhnen (1989) on excavated contexts of the Carmel region of Northern Israel. Other parallels come from a typo-chronological study by Magness (1993) on published material from excavations in Jerusalem. The same holds for the study by Renel (2010) that includes ceramics from various excavated contexts in the Hauran region of Southern Syria.

Parallels were also found in the extensive pottery reports from the excavations at Tell Hisban (Gerber 2012; Walker 2012). These ceramics were excavated in the 1970s, but because their original contexts are largely unknown (Herr 2012, 5) they could only be dated on the basis of the original typology of the Tell Hisban ceramics and comparative evidence from other sites. Nevertheless, the publications appear to be thorough in terms of the large number of cited parallels, and were therefore considered for comparative purposes as well.

Other dating criteria

Two types of decoration were encountered numerously on the ceramics from the Jebel Qurma region, and these could be attributed to the Byzantine and Early Islamic periods. The first is painted decoration, executed in various colours including orange/red, brown, purple, and grey, applied on a lightly-coloured surface. In a regional comparative study by Hendrix et al. (1996) this kind of painted decoration is dated to the Late Byzantine period, when multiple colours and motifs were used on differently coloured wares, including white paint on grey ware, and red-orange paint on buff ware. Subsequently, during the Umayyad period painting occurs in red, white, purple and brown, and is applied in different motifs. This type of painting continues into the Abbasid period. Limited painting occurs in the Fatimid period, and is discontinued altogether after that (Hendrix et al. 1996, 238-79). These observations are largely paralleled when looking at a number of individual sites. At Dhiban so-called "red-on-light" painted ceramics already appear at the very end of the 6th or early 7th century and continue into the Umayyad period (Tushingham 1972, 67-76). At Pella, so-called "red-on-cream" ware seems to continue into the 8th century (Smith 1973; Smith & Day 1989). Parker contends that this red-on-cream painted decoration should be attributed to the 8th and 9th centuries, while white-on-grey paint can be dated more generally to the Late Byzantine and Early Islamic period (Parker 1998, 215). It thus seems that the ceramics from the Jebel Qurma corpus that show painting in various colours on light wares can be safely attributed to the Late Byzantine, Umayyad or Abbasid periods (see § 3.6.).

The second type of decoration is represented by lightly incised parallel lines characterised as "combing". In the regional comparative study by Hendrix et al. (1996) combing is shown to appear already in limited amounts in the Early Byzantine period and is widely attested in the Late Byzantine, Umayyad and Abbasid period. Fatimid and later ceramics do not have combed decoration. They also show that combing was usually applied on large jars and basins (Hendrix et al. 1996, 238-79). Looking at individual sites, combing appears in Pella in the 6th-early 7th century (Smith & Day 1989, Pl. 50:24), and perhaps even earlier at Beth She'an where it is dated to the Byzantine period (Johnson 2006, Fig. 15.13:274, 275). At Dhiban combing seems to continue into the 8th century (Tushingham 1972), and at Ramla combing also appears on Abbasid ceramics (Cytryn-Silverman 2010, Pl. 9.10:4). At Khirbet Yajuz combing is also attested on Abbasid pottery, where it continues into the 10th century (Khalil & Kareem 2002). Summarising, it seems safe to ascribe a Byzantine to Early Islamic date to sherds with combed decoration.