



CURRENT APPROACHES TO ROMAN FRONTIERS

HARRY VAN ENCKEVORT, MARK DRIESSEN, ERIK GRAAFSTAL,
TOM HAZENBERG, TATIANA IVLEVA AND CAROL VAN DRIEL-MURRAY (EDS)

LIMES XXV VOLUME 1



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Nijmegen

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Research on the effects of relative sea-level change on the river Exe estuary in the mid-1st century AD (South-West Britain)

Stephen J. Kaye and John Pamment Salvatore

Relative Sea-Level (RSL) change since the mid-1st century AD places limits on the locations of Roman ports on the river Exe (fig. 6). Supplies from Northern Gaul, destined for the Neronian fortress at Exeter and its dependent civilian sites, may be demonstrated to have been unloaded downriver from the fortress at Exeter. Utilising a combination of available historical and archaeological data, glacial isostatic adjustment and estimated RSL over the past 2000 years, confirms that Roman sea-transports or river barges could not have reached the Exeter fortress on the tide. Furthermore, on the basis of the estimated tidal reach and depth of the river Exe in the mid-1st century AD, limitations may be placed on the location of both sea-port and barge-quay facilities, thus allowing the areas of search for these installations to be narrowed (Kaye & Salvatore 2022).

Relative Sea-Level (RSL)

The values of RSL can change due to both eustatic sea-level variations and Glacial Isostatic Adjustment since the last glacial event. Figure 1 shows the RSL for Devon from c. 10,000 B.P. to the Middle Ages and displays the forebulge collapse due to the removal of the Celtic Ice Sheet. The polynomial line through the data points shows that the RSL was approximately -25 to -20 m Ordnance Datum (OD) some 12,000 years ago, meaning that the land surface was that much higher than it is today. By the 1st century AD, the RSL is at c. -2.5 m OD and the land continues to subside to this day. The consequences for the fluvial and tidal regimes are considerable, effecting the navigability of the Exe and the placement of a sea-port and/or barge-quay that might have served the fortress of *Legio II Augusta* at Exeter.

Historical information

The first reference (Delagarde 1840) to the tidal regime occurs at the end of the reign of Edward the First (AD 1272-1307) when John Hooker writes in the ‘Haven of Exeter’ that: “The river Exe is naturally only navigable for large vessels as far as Topsham, on the left bank of the river [east], four miles below Exeter. Smaller craft, however, and large barges,

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Relative Sea Level Change (Devon)
Shennan, et al., 2018

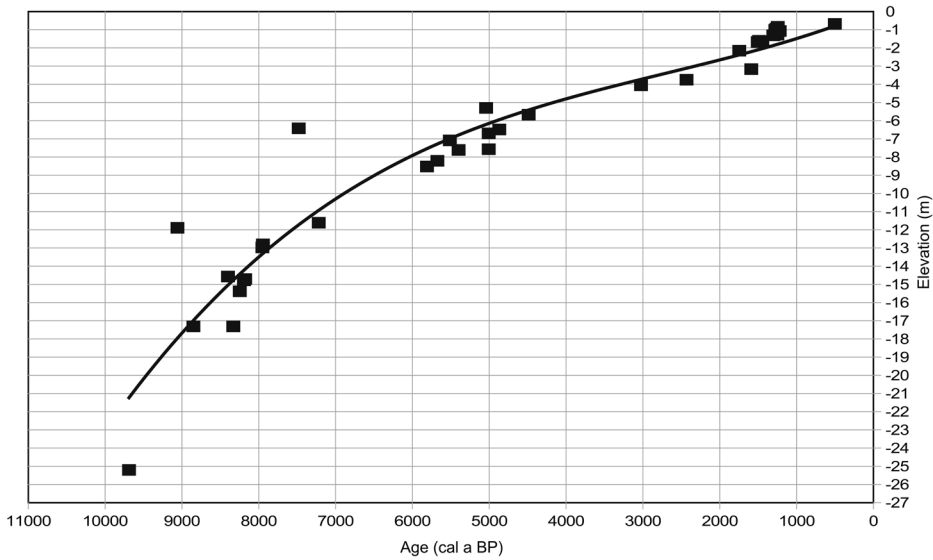


Figure 1. Age-elevation plot of sea-level index points for Devon (data from Shennan *et al.* 2018).

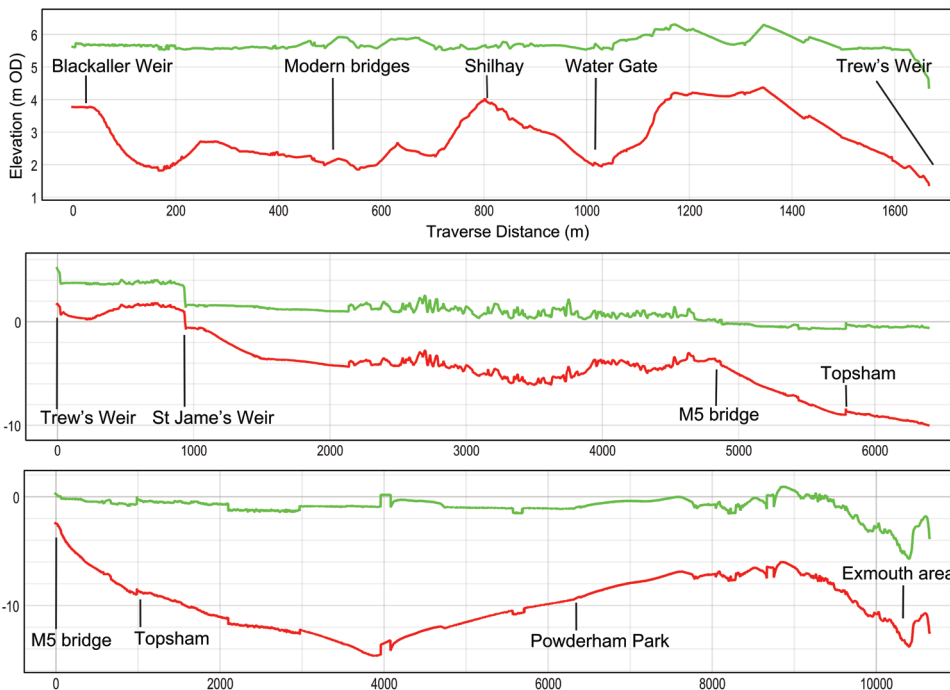


Figure 2. Present-day bedrock (red line) and overburden (green) profiles along a North to South transect of the river Exe.

could with the tide ascend to the water-gate of the city, in sufficient numbers to supply the wants of the inhabitants.” Subsequently, in about AD 1300, a weir was constructed upstream of Topsham which blocked the tidal ingress and barge transport to the city.

Modelling of Relative Sea-Level change

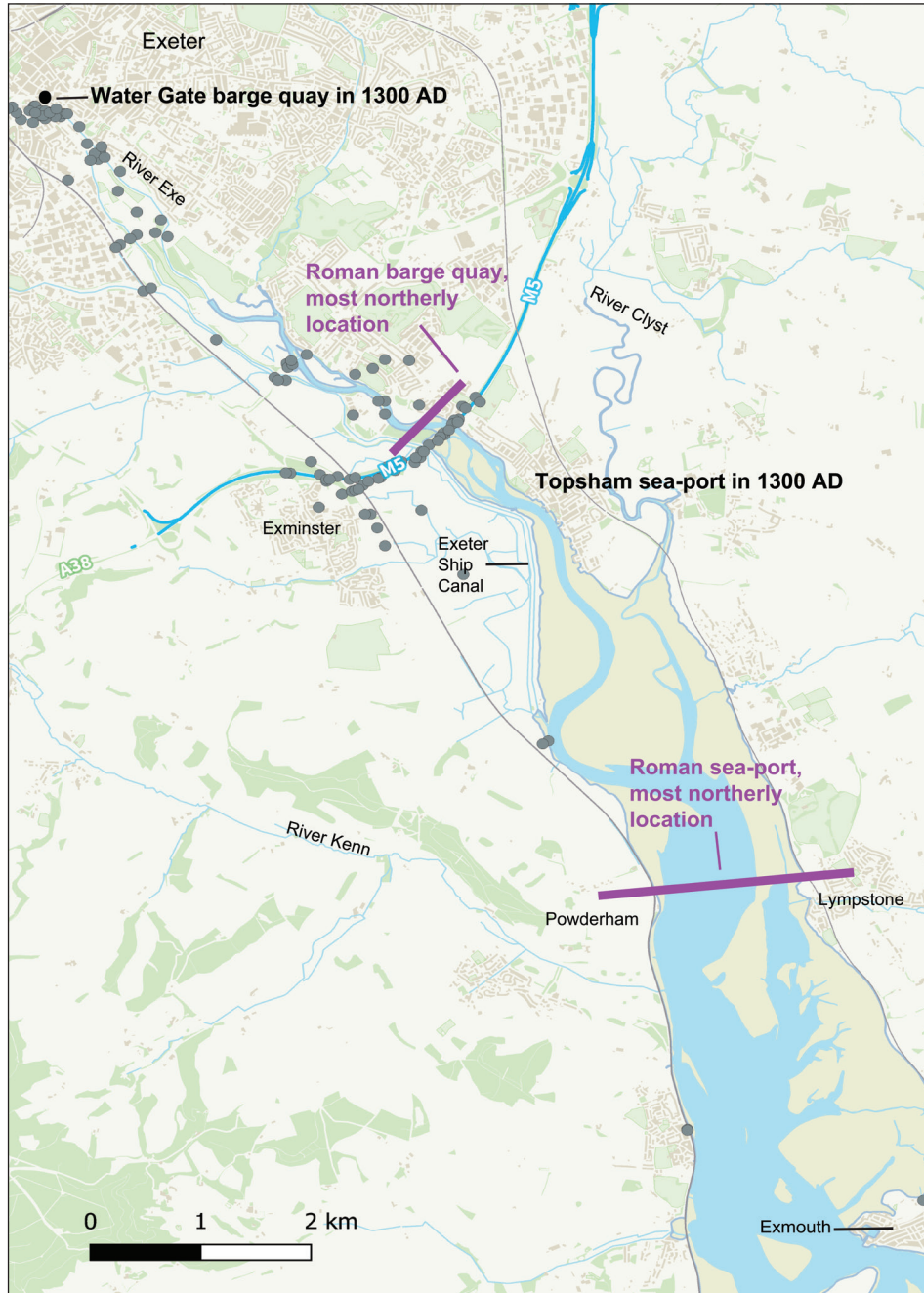
The pre-AD 1300 tidal head at Exeter and the sea-port at Topsham were used as data anchors to ask the question:

how much further south – the differential fall distance – would those locations have been in the 1st century AD? Topographic slopes down the Exe river and estuary were calculated: the best estimate was 0.02 degrees. These slopes were used to calculate the differential fall distances due to the RSL changes (best estimate -1.5 m) since the 1st century AD, *i.e.* how far has the tidal body fallen down the slope as time retrogressed to the Roman era (table 1)?

Table 1. Differential fall distances (m) from AD 1300 to the 1st century AD for RSL values of -1.5 to -3.0 m, in -0.5 intervals, and slope values of 0.01, 0.02 and 0.03 degrees.

RSL differentials AD 1300/1 st century	-0.5/-1.5 m	-1.0/-2.0 m	-1.5/-2.5 m	-2.0/-3.0 m
slope 0.01	2,864.79	5,729.58	8,594.37	11,459.16
slope 0.02	1,432.39	2,864.79	4,297.18	5,729.58
slope 0.03	954.93	1,909.86	2,864.79	3,819.72

Figure 3. Map of differential fall distances to the most northerly locations in the 1st century AD for the AD 1300 barge-quay located at Exeter and the sea-port at Topsham. The differential RSL and slope values were the best estimates at -1.5 m and 0.02 degrees, respectively, resulting in a differential fall distance of 4,297 m. See figure 4 for the locations of all the differential RSL and slope values from the present-day to the 1st century AD.



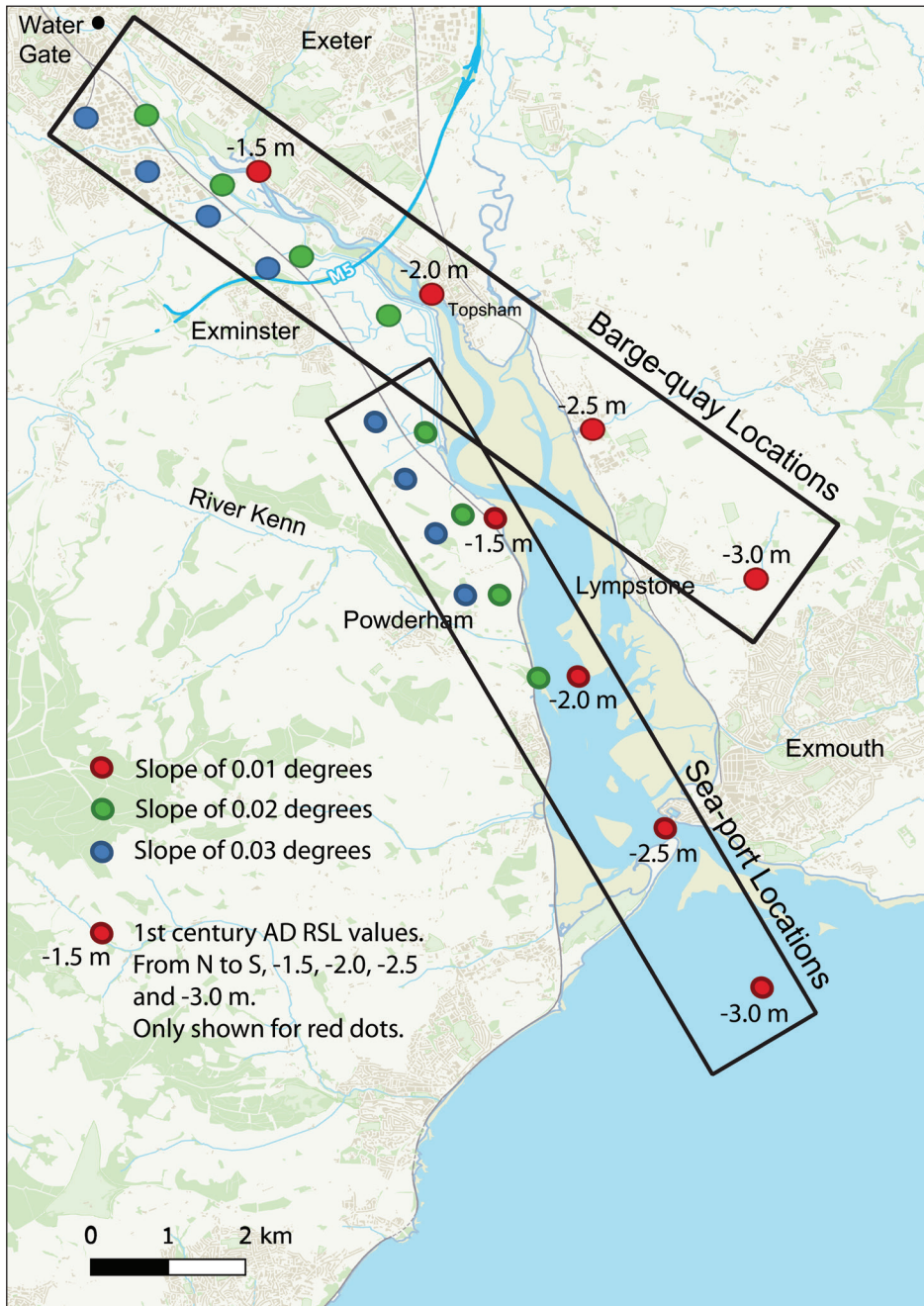


Figure 4. Map of the most northerly, or upstream, limits of 1st-century AD barge-quays and sea-ports. Differential fall data, from the present-day to the 1st century AD. For any combination of slope and RSL value the barge-quay or sea-port could not be placed further upstream or north than the relevant coloured dot.

Taking the best estimates of slope and differential RSL, 0.02 degrees and -1.5 m respectively, the fall distance was 4,297.18 m, that is, any AD 1300 tidal datum location might have been over 4.2 km further south in the 1st century AD (fig. 3). Demonstrably there was no barge-quay at Exeter in the 1st century AD because the tide did not reach that far upstream. Instead, a barge-quay may only have been located as far north as the vicinity of the M5 Motorway bridge (figs 3-4). Furthermore, assuming that the AD 1300 sea-port at Topsham was located as far upstream as practical, a Roman era sea-port may only have

been located south of the line Powderham-Lympstone for the same RSL and slope values (figs 3-4).

Tidal inflow simulation

A simulated tidal inflow into the Exe estuary and river valley was performed; it supported the findings of the previous RSL examinations with an additional set of limits on the positioning of the 1st-century AD sea-port and barge-quay. First, the extant boundaries to tidal inflow were eroded and partially breached in the tidal modelling of the present-day regime (fig. 5A). Second, 1st century AD

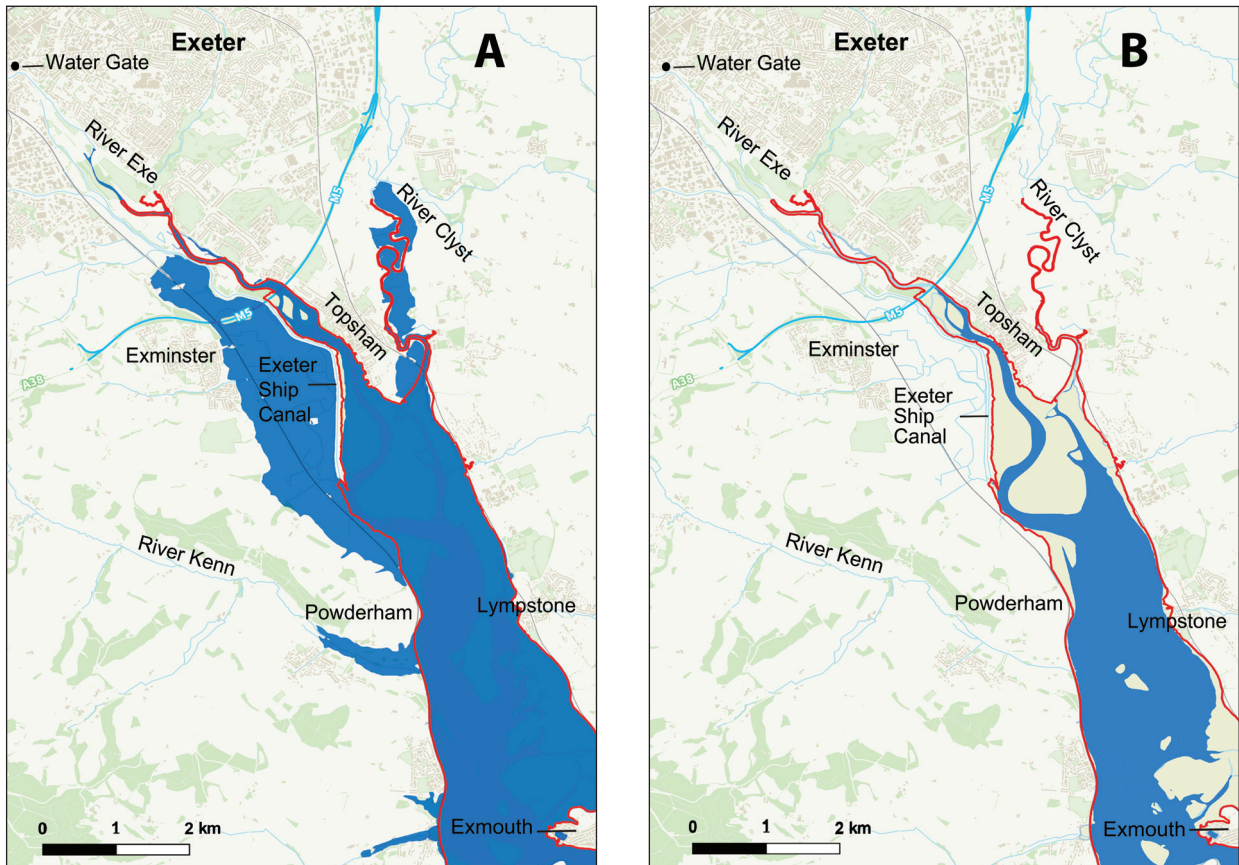


Figure 5. A. Simulated tidal influx for the present-day after the partial removal and breaching of anthropogenic structures. Red line is the Ordnance Survey High Water Mark. Grey lines are of the railways. B. Simulated tidal influx for the 1st century AD. RSL -2.0 m. Note that the modern anthropogenic structures have been partially removed and breached and may still restrict the 1st century AD flow, e.g. the river Kenn may have been tidal in its lower reaches.

modelling was achieved by raising the topography by only 2 m, i.e. imitation of a -2.0 RSL (fig. 5B). As a result, the tidal head was downstream of the M5 bridge and at Topsham the tidal water depth was c.0.5 m. The results suggest Topsham was not a Roman sea-port but may have been a barge-port.

Archaeological context and conclusions

A mid-1st-century AD fortress at Exeter in SW Britain (constructed c. AD 50-55) is known from excavation to have been occupied by *Legio II Augusta* until perhaps the greater part of the legion was transferred to Caerleon in Wales around AD 75 leaving only a reduced garrison (Bidwell 2021, 154-156). Subsequent to the identification of the fortress in 1971, many contemporary civilian sites, dependent upon the fortress for their existence, have been discovered alongside or straddling the known Roman road leading from the south gate of the fortress to a location near the head of the river Exe estuary some 5.2 km south-east of Exeter (Bidwell, 2021, 140-149). These sites, include buildings associated with the *canabae*

legionis (Salvatore 2021); a defended civilian settlement (*vicus*) at the former St Loye's College, 2.6 km south-east of the fortress (Salvatore *et al.* forthcoming); parallel strip buildings (possibly warehouses) at the Aldi supermarket site close to the head of the estuary just NE of Topsham (Garland & Orellana 2018) and a rectangular (row-type) building close to the Aldi site on the route of the M5 (Jarvis & Maxfield 1975) (fig. 6).

Paul Bidwell (2021, 138), the excavator of the military bath-house at Exeter has stated: "Looking across the whole sweep of the European frontier from Scotland to the Black Sea, Exeter is now known to have the largest series of dependent sites amongst fortresses dating to between the Augustan and early Flavian periods." The extent of potentially the largest of these dependent sites (the St Loye's settlement) is unknown but at least part of it was enclosed by military-style defences which included an outer V-shaped ditch and an inner Punic ditch. The pottery evidence, including copious amounts of amphorae sherds, suggests that St Loye's was occupied by civilian traders engaging in the supply and distribution

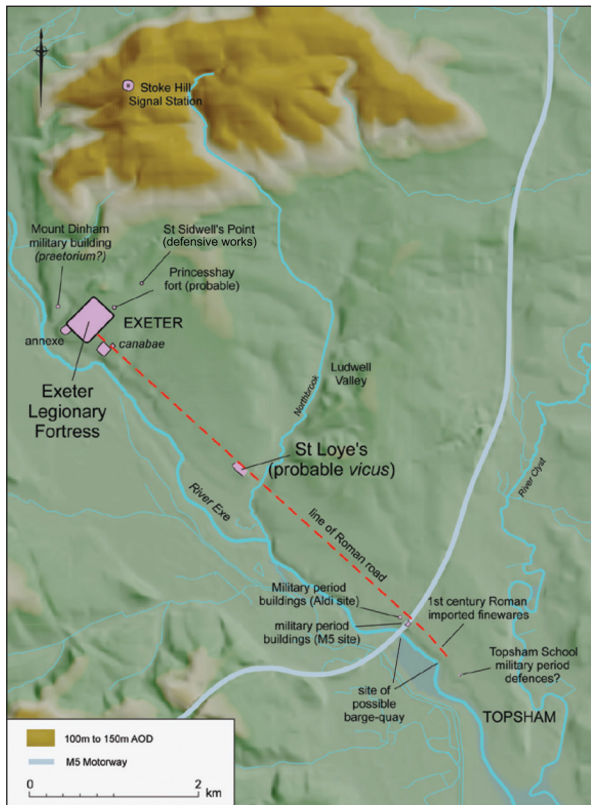


Figure 6. Roman military period sites located between the fortress at Exeter and the Topsham School site showing the approximate site of the possible barge-quay.

of imported goods and food stuffs from Gaul to the Roman garrison at the Exeter fortress and the auxiliary forts beyond.

The presented research offers some insight into the supply of goods from the Continent via cross Channel shipping. Namely, that tidal constraints within the Exe estuary would have prevented sea-going vessels (or even barges) from reaching the Exeter fortress itself. Whilst the cargo could have arrived at a sea-port on the estuary south of Lympstone, no evidence exists of a Roman military presence that far south. The current, favoured explanation is of a transshipment of goods from sea-going vessels to barges on the lower reaches of the Exe estuary; with those barges then travelling up-river to a barge-quay south of the mid-1st-century tidal reach of the Exe in the Topsham area; thenceforth, transport was by road (fig. 6).

Acknowledgements

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