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Reasoning with GIS : Tracing the Silk Road and the Defensive Systems of the Murghab Delta (Turkmenistan)

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Over the past fifteen years, a major joint Italian-Russian-Turkmen project has enabled the creation of an archaeological GIS of the Murghab delta. This project has involved some fifty different specialists, resulting in numerous studies and a preliminary project publication [Gubaev et al. 1998]. The GIS is still under construction. However, it already includes over 1000 sites with associated archaeological data and a great deal of cartographic and other geographical information. The project evolved at a time when GIS was only just starting to be applied to archaeology, and all information was classified in codified categories developed *ad hoc* for this purpose.

The Murghab delta is a terminal alluvial cone situated in the Karakum desert of Turkmenistan (Fig. 1). The only supply of water before the construction of the massive Karakum Canal during the Soviet period came from the Murghab River itself, a single trunk-course deeply encased near its source in the hilly piedmont of the northern Paropamisus (Afghanistan), which spreads into a wide alluvial fan of rich farmlands in the terminal delta. This became one of the largest irrigated areas in Central Asia as early as the Bronze Age. After Alexander's conquest in 332 BCE, Margiana, and in particular the ancient capital of Merv, developed as a nodal point along one of the most active Silk Road sections, opening direct trade relations with China [Cattani et al., p. 125; Bader et al. 1993-94, p. 51].

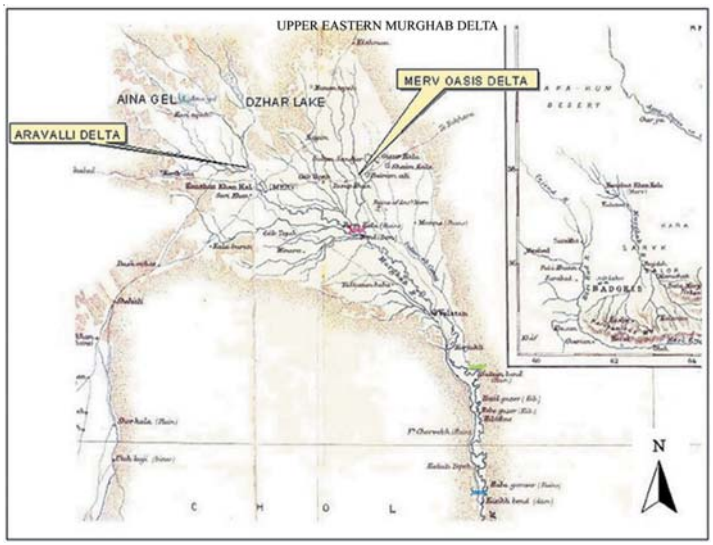

Fig. 1. The Upper Eastern Murghab Delta.

While developing the archaeological map of the Murghab delta from field surveys and archival data of the Soviet period, we have assembled a vast collection of maps and rare data concerning the climate, soil, vegetation and economy of the region, including statistical spreadsheets from government agencies from the late 19th century to World War II [Cerasetti 2000-2001]. One of the main aims of our research concerns the definition of the chronological sequence and reconstruction of the main irrigation systems, elaborating the data on the river's morphological evolution by means of GIS applications. Surface and historical mapping [Abbott 1843; Stewart 1881;

Lumsden 1885] and intensive walking transects with aerial photos from low altitudes and space platforms (CORONA 1964, Landsat-7 2001, NASA Landsat Mosaic 1999, IKONOS 001 [Ziebart et al. 2002]), as well as reconnaissance flights for oblique observation along sub-fossil meanders, allowed us better to understand the main changes characterizing the life of the Murghab river [Cerasetti 2002; Cerasetti and Mauri 2002].

One of the first targets is a fine-grained reconstruction of the delta configuration before the large scale development projects carried out under Russian rule (Fig. 2). The combined support of digital archive data from GIS and the analysis of satellite imagery of the alluvial fan allow us to understand the complex processes based on settlement fluctuation, and to reconstruct the palaeochannel network of the Murghab delta (Fig. 3).

Fig. 2. Ancient dam of the Sultan Band.

Another aspect under investigation is the evolution of patterns of fortification.The employment of remote sensing data allowed us to study the defensive fronter systems in Margiana from the Iron Age 2 (Yaz II/900-550 BCE) until the Parthian period (190 BCE-550 CE). Before the consolidation of Achaemenid central power, two impressive south-north fortress lines were erected along the northeastern side of the Murghab delta [Genito 1998, p. 125, Fig. 1], probably defending the cultivated area and the main waterworks (Fig. 4). The lack of water must have been a problem for the subsistence of an increasing population and the water source control of the Murghab River presumably corresponded to a "territorial control" of the Margiana region. Today much of the Murghab delta is covered by vegetation, making it impossible to collect data by survey. However, the observations made on CORONA satellite imagery have made it possible to localize the southernmost complex of the eastern frontier, known as Garry Kishman [Cerasetti and Mauri 2002, p. 2], founded during the Iron Age 3 (550-340 BCE) period (Fig. 5, next page).

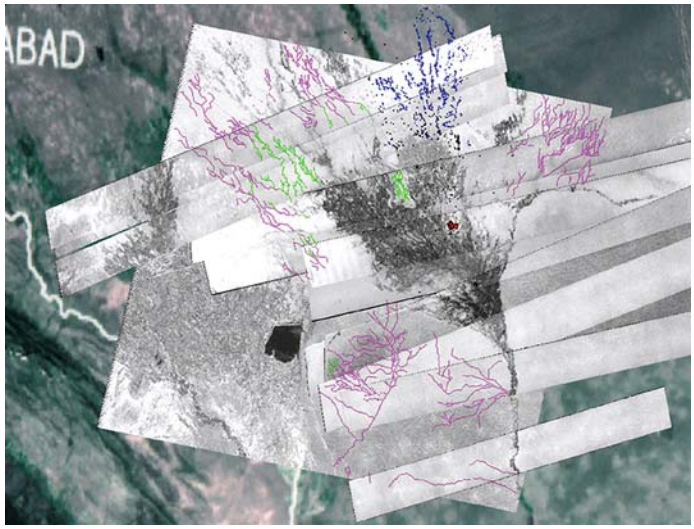

Fig. 3. Reconstruction of the palaeochannel network of the Murghab delta.

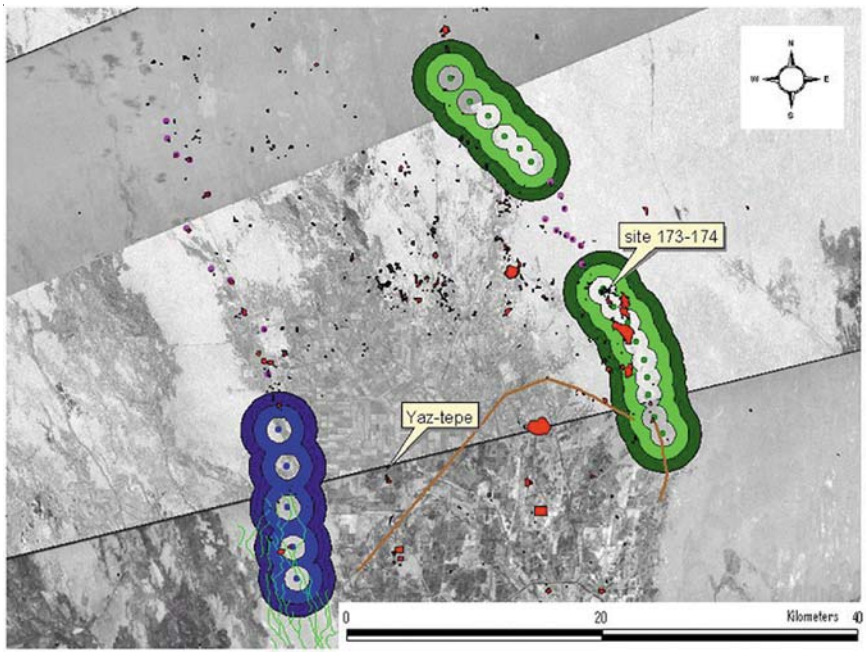

Fig. 4. Fortress lines along the northeastern side of the Murghab delta.

With the beginnings of large scale trade along the Silk Road, we can detect the appearance of another form of fortification. By using multispectral ETM Landsat images from NASA Landsat Mosaic (1999) (Fig. 6) we have been able to locate a line of fortresses along a new Silk Road section to the

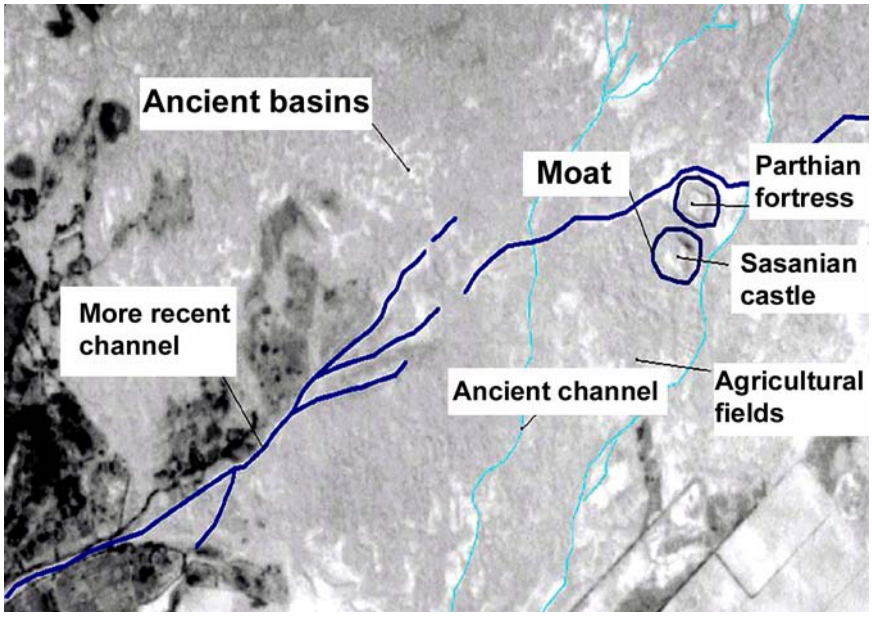

Fig. 5. CORONA detail of Garry Kishman.

north of the Samarkand-Hecatompylos trade route, crossing Merv in the Murghab delta. We singled out seven rectangular plan fortresses, measuring approximately 10 ha. each, and situated at a distance of about 50 km (Fig. 7, next page) along the Kelif Uzboi riverbed, the southernmost dry canal of Uzboj [so-called in Russian scholarship: Bader and Usupov 1995, p. 29, Fig. 1]. The fortresses are well defended by impressive walls, and their regular plan and their size suggest a date in the Parthian period. Many exotic high-quality objects have been found dating to this period, a fact linked to the increase of trade exchanges between China and the Parthian kingdom of the Arsacids, in particular under Mithradates II (123-87 BCE) [Boulnois 2001, p. 59; Frye 1984: 360; Bader and Usupov 1995, p. 27; Callieri in press, p. 541].

The fortresses probably defended caravans and exotic goods coming from Bukhara or Khiva and also constituted a rest point for travelers and animals. Pack animals were mainly camels, the most adapted species to hot and dry climates and, in particular, to long distance travel across the Central Asian deserts [Wapnish 1981, pp. 104, 108, 121]. Numerous and different criteria characterized caravan travel of the time: camel number, loaded weight, strong temperature range etc. "...the average rate was fifteen to sixteen miles [per eight-hour day] for a heavily laden caravan, seventeen to eighteen for a moderately laden, and twenty to twenty-two a day of ten hours for a lightly laden caravan" [Zoghby, p. 1]. This means that a distance of 50 kms. (= 31 miles) from one station to the next corresponds to approximately a two-day journey, and maybe a one-day journey for a lightly laden caravan [Boulnois 2001, p. 209-210]. From Hecatompylos to Bukhara at the North of Merv, a lightly laden caravan would therefore employ three weeks to cover 1046 km. (= 649 miles), crossing the Amu-darya river in the proximity of the modern centre of Chorjuyu. We hope to confirm the present working hypothesis by the acquisition of higher resolution imagery.

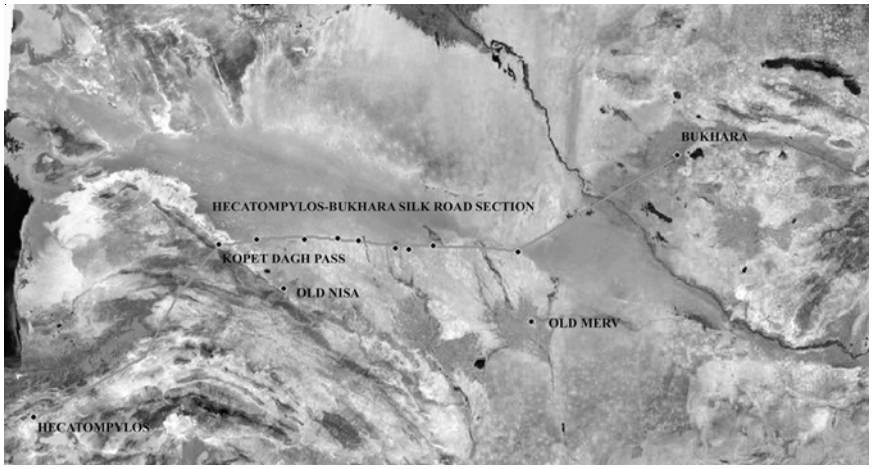

Fig. 6. NASA Landsat Mosaic with Hecatompylos-Bukhara section of Silk Road

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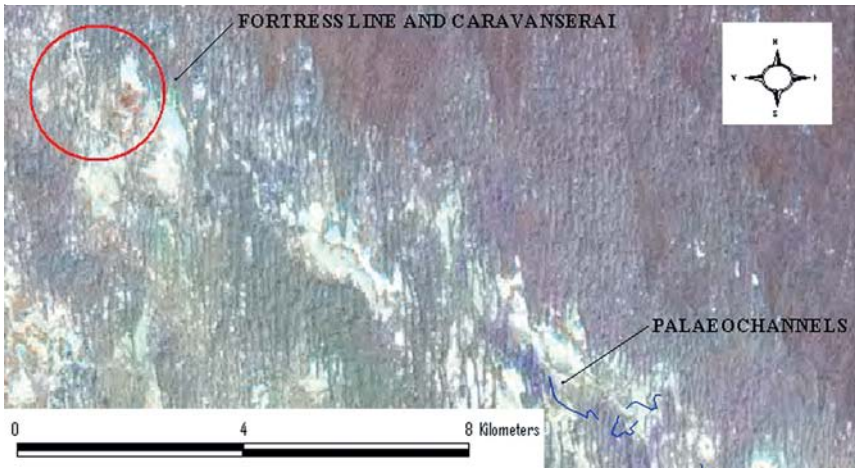

Fig. 7. Detail of one of the Parthian fortresses.

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