

## ARCHAEOSEISMOLOGY IN IRAN AND THE NEED FOR REVISITING HISTORICAL EARTHQUAKES CASE STUDY: M=7.9, 856 AD QUMIS EARTHQUAKE PROCLAIMED AS DEADLIEST EARTHQUAKE IN IRANIAN PLATEAU

Alireza ALINAGHI

Assistant Professor, IIEES, Tehran, Iran

alireza.alinaghi@gmail.com

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Iran has a long history of devastating earthquakes which have claimed lives of hundreds of thousands of people both in ancient and modern times. In fact Iran is high on the list among 10 countries with earthquake fatalities both in terms of the absolute number of casualties and the number of deaths divided by population (Figure 1-a). Moreover, in terms of the number of significant earthquakes in documented history Iran tops the list (Figure 1-b).

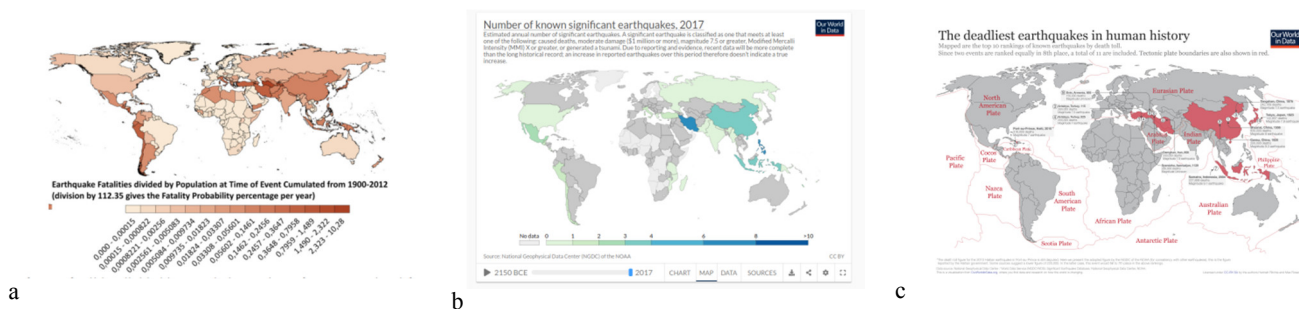


Figure 1. (a) Earthquake fatalities around the world divided by population, (b) Countries with respect to number of significant earthquakes, (c) The deadliest earthquakes in human history with Qumis event as number 8.

The focus of this study is Qumis earthquake of 856 AD with reported death toll of 200,000 (Ambresseys and Melville, 1982, NOAA). It is among the top 10 deadliest earthquakes in human history (Figure 1-c). But, the question is whether this death toll and magnitude can be ascertained by inspecting archaeological remains and historical records? Answering this question is important because it has tremendous bearing on seismic hazard assessment and the potential of Astaneh fault, the reported causative fault of the earthquake (Hollingsworth et al., 2010) for generation of an earthquake with such a magnitude.

To answer the above question we have examined both documented history and archaeological monuments already discovered and mapped in the area.

First of all it must be stated that the greatest loss of lives in Iranian earthquakes which has been attributed to Qumis earthquake stems from references to Yaghubi history (Mathew et al., 2019). The account of this earthquake like many other reports of events in his writing is accompanied by gross exaggeration. Therefore, basing the number of fatalities and hence the magnitude of the event solely on such evidence does not seem plausible.

Secondly, the assumption made that a once flourishing Shahr-i Qumis (Hecatompylos) was devastated by the earthquake and abandoned afterwards (Hollingsworth et al., 2010) seems inaccurate. According to archaeological finds Shahr-i Qumis which is now close to Qusheh, around 35 km southwest of Damghan (Hansman, 1968) had been deserted and sealed in the first century BC by Parthians as they moved their capital farther to the west (Hansman and Stronach, 1971). Besides the excavations at the site shows intact adobe structures made of mud and bricks (Figure 2) which are not expected to have survived a M=7.9 earthquake at a distance of only 20-30 km away from the earthquake rupture.



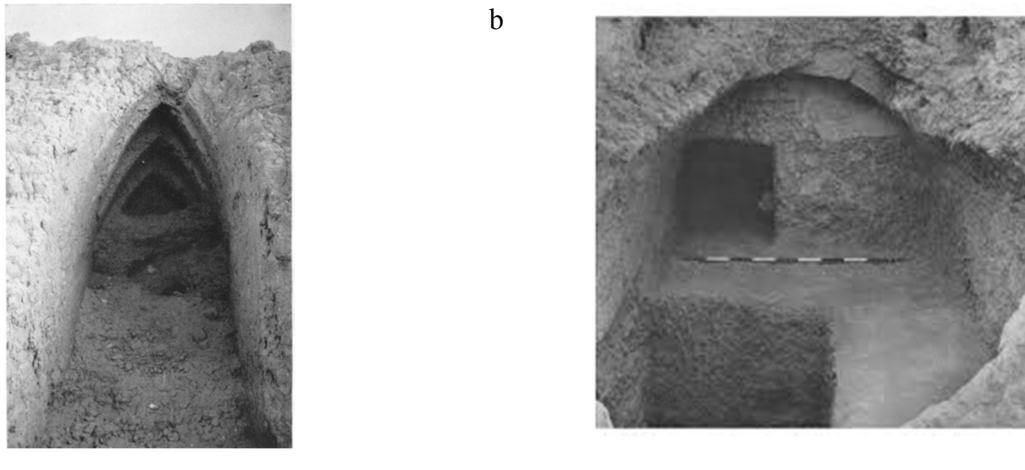


Figure 2. Excavated sepulchral vault (a), and residence structures (b) of Sahr-i Qumis, made of bricks and dated back to 1<sup>st</sup> century BC (at the latest) which show no sign of a devastating earthquake.

Thirdly, the palaeoseismological study conducted on Astaneh fault (Hollingsworth et al., 2010) as the earthquake fault shows offset of around 10-20 cm which seems too little for an earthquake with such an estimated magnitude.

It is suggested that the archaeological stratigraphy performed for historical sites in the area, Shahr-i Qumis and Tepe Hissar should be reevaluated with respect to possible earthquakes induced features. It is also recommended that Tari-Khaneh mosque as the only structure which has been built prior to the earthquake and has undergone periodic restorations after the earthquake be examined thoroughly to find possible evidence for Qumis earthquake and/or subsequent events. In this respect dating the construction materials seems imperative to shed light on the unknown history of one of the oldest mosques in Iran and will hopefully provide information on the magnitude of Qumis earthquake.

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- National Geophysical Data Center/World Data Service (NGDC/WDS): NCEI/WDS Global Significant Earthquake Database. NOAA National Centers for Environmental Information.