

## 3D modelling for digital preservation repositories of stone monuments that records historical earthquakes at Shikoku region

\*Wataru Tanikawa<sup>1</sup>, Uramoto Go-Ichiro<sup>3</sup>, Shoichiro Uchiyama<sup>2</sup>, Arata Orinaka<sup>3</sup>, Tadashi Yamashina<sup>3</sup>, Keisuke Okamoto<sup>4</sup>, Tadashi Hara<sup>3</sup>

1. Japan Agency for Marine-Earth Science and Technology, Kochi Institute for Core Sample Research, 2. National Research Institute for Earth Science and Disaster Prevention, 3. Kochi University, 4. Kochi Prefectural Museum of History

Earthquake stone monuments (slab) related to historical tsunami earthquakes are built in coastal areas at Shikoku Island, Japan. These monuments have functions to remain the record about ancient natural disasters, and transmit records to posterity, and offer for the dead. Several stone markers describe warning messages and indicate maximum tsunami inundation height for past earthquakes. Therefore, these stone slabs could be used in school education programs for disaster prevention, though most of monuments are simply ignored. The reason for the ignorance or forget of monuments is difficulty to access for public people the information about stone monuments and related documents, to read the old characters, and to learn future disastrous earthquakes from the monuments. Most monuments are built outside near coast, therefore the stone would be damaged by weathering by wind and rain, or be lost by future tsunamis.

Therefore, in this study, we constructed a database of the stone monuments for historical earthquakes in Shikoku Island, Japan, by integrating the 3D digital archive models, descriptive contents, rock physical and chemical properties, and location-based information.

We have built more thirty than 3D models so far, and organized information of the earthquake monuments in Kochi Prefecture, Japan. We used the commercial software (PhotoScan, Agisoft Company) to reconstruct 3D models from digital photo images. Photos were taken by compact digital camera (GR, RICOH imaging company) and edited the photo image by using Photoshop software (Adobe Systems Incorporated) with exposure adjustment and white balance fixing to enhance the engraved characters. 3D data were uploaded on the existing platform (Sketchfab, <https://sketchfab.com/>) so that anyone can observe the 3D models through web browser based on the WebGL technology. 3D pdf format files were also prepared to view 3D models on your own PC for offline use. Both Sketchfab and 3Dpdf have the annotation tools that small notes can be stuck on the model. Therefore, we added the information of contents and interpretation on the 3D models using the annotation tools. Rock type and rock physical and chemical properties of stone materials can help for provenance study. Therefore we added these information (rock magnetic susceptibility and color) in database. We used “e-community platform (<http://ecom-plat.jp/>)” web system which was developed by National Research Institute for Earth Science and Disaster Prevention in Japan to introduce the position of the monument through map. We categorize the stone monuments according to the associated earthquake events and locations. We plan to overlay the tsunami hazard map published by public institutes to confirm the relationship between tsunami inundation distribution and the location of monument.

3D reproduction made by 3D printer could be used for teaching materials and exhibitions in historical museums. We plan to launch the web database soon after completing the dataset of stone monuments at Kochi prefecture.

Keywords: Nankai Earthquake, digital archive, earthquake monuments, PhotoScan, sketchfab