**Summary of Files Provided for WVU DDU Project by Sarah Brown**

**November 12, 2019**

This document is a readme file for the WVU project work completed by Sarah Brown in Fall/Winter 2019. If you experience issues with any of the files, or have questions about them, please contact Sarah Brown at sbrown@geosrv.wvnet.edu.

**Software Requirement Note**

Free software may be required to view some of the information provided. Software used for data analysis include ilastik-1.3.0b4, FIJI and ImageJ2

**Readme File Description Layout**

Items listed in this document are sorted by tab indentations and are described as follows:

**Folder:** Description

 **Folder Contents**

Content Description

**DDU Geothermal\_Clay 513\_CT scans**: Contains image files for Medical CT scans of the Clay 513 well. These images are a reslice through the center of the core and represent a 2D image of the core. Color variations are a proxy for density differences in the core. Each image represents a scan from one core box, ~ 3 feet in length.

**DDD Geothermal\_Harrison 79\_CT scans**: Contains an image file for a Medical CT scan of the Harrison 79 well. This image is a reslice through the center of the core and represent a 2D image of the core. Color variations are a proxy for density differences. The image represents a scan from one core box, ~ 3 feet in length.

**Preston\_119**\_**CT scan data: Contains** Characterization data collected from analysis of the Preston 119 core. CT scanning was collected with a Toshiba® Aquilion TSX-101A/R medical scanner. The CT scanner generates images with a resolution in the millimeter range, with scans having voxel resolutions of 0.43 x 0.43 mm in the XY plane and 0.50 mm along the core axis. The scans were conducted at a voltage of 135 kV and at a current of 200 mA. Subsequent processing and combining of stacks was performed to create three-dimensional (3D) volumetric representations using ImageJ to produce Tiff stacks. The variation in grayscale values observed in the CT images indicates changes in the CT number obtained from the scans, which is directly proportional to changes in the attenuation and density of the scanned rock. Darker regions are less dense and absorb less x-rays.

* + 1. **Exported segmented files full**

Contains the files produced after segmentation in ilastik. They can be viewed in several image processing programs including ImageJ2 or FIJI. After importing the segmented tiff stack for a core section into one of the image processing programs you can view the volumes and calculate the percentages by following the instructions in the '% volume by CT calc' powerpoint. The background (air/outside) is subtracted and the percent volume of fractures can be determined for the entire sample. These segmentations and associated calculations were performed on entire scans (2 to 3 foot sections of core, one length of core box); these can be refined if a small subset is chosen. With a smaller subset, additional artifacts can be removed such as beam hardening and edge effects.

* + 1. **ilastik segmented files**

Contains files produced using the interactive learning and segmentation toolkit ilastik. The premise of isolating features is to first segment out the feature based on its unique grayscale value. Once this isolation has occurred, the next steps are to differentiate multiple isolated features and then combine them into one coherent visual representation.

* + 1. **Tiff stacks**

The 'Tiff stacks' folder contains the original stacks collected from the medical scanner in a .h5 format which is easier to use in ilastik. The grayscale values in the Tiff stacks were used to isolate and visually differentiate objects of interest in the scans (in this case: matrix, fractures and air/outside).

* + 1. **Percentage volume by CT calc.pptx**

Contains explanation of how volume percentages were calculated in FIJI/imageJ2 after segmentation.

* + 1. **CT summary.docx**

Contains explanation of the parameters used in CT data collection and how segmentation was used to produce volume percentages.

* + 1. **CT\_Read\_me.txt**

Contains explanation of the files in this folder.

* + 1. **Netl-trs-9-2018-ct-of-the-tuscarora-sandstone-from-the-preston-119-weel-final-20180509**

Contains technical report produced by NETL on the CT scanning of the Preston 119 core.

* + 1. **Tusc fracture volumes by CT v3 all boxes.xlsx**

Contains fracture volume percentage of the Preston 119 well after filtering to remove edge effects. The data is listed by tiff stack which represents 1 core box or approximately 3 feet of core.

* + 1. **Preston 119 CT scan fracture estimation.xlsx**

Contains early version of fracture volume percentage of the Preston 119 well after filtering to remove edge effects. The data is listed by tiff stack which represents 1 core box or approximately 3 feet of core