# Research on statistical observation of columnar joint form and its origin by high precision 3D model by drone and potato starch experiment

*Makoto Iida[1], *Ryo Aoki[1], *Ryuki Mochizuki[1], *Takato Okumura[1]

1. Nirayama High School

Many columnar joints which were formed by volcanic activity. can be seen on the Izu Peninsula. Therefore, we conducted research to statistically clarify the characteristics of the cross-sectional shape of columnar joints formed by geometric patterns, and to clarify the relationship between statistics and a mass of igneous rock formation conditions.

We did our research in three ways. First, we took an aerial photograph using a drone at Hutou coast in Nishiizu, Shizuoka Prefecture. From that, we created orthographic images, created polygon data using QGIS, and collected the number of corners and area fom the data. Graphing the data and comparing it with last year's data, it was shown that the columnar joints surveyed last year had the most hexagons, but the columnar joints at Hutou coast mainly formed pentagons, and the number of corners was widely dispersed. From this, we thought that the columnar joints on the Hutou coast were formed of thin dikes, and that the cooling condition was poor, which could cause variations in the angular distribution.

Second, we collected data on the angular distribution of various columnar joints around the world from foreign literature, and examined their correlation with the Hutou coast and the columnar joints examined last year. The literature shows that a burnt island dyke is a columnar joint formed of thin dikes, while others are columnar joints formed of thicker rocks. Also, the columnar joint in foreign countries have more hexagons, and the Hutou coast's kurtosis has lower levels than domestic and foreign columnar joint's kurtosis. From these, we can see that columnar joints made in relatively thick lava or magma have more hexagons and a higher kurtosis, but the columnar joints of thin dikes have a variable number of corners and a lower kurtosis.

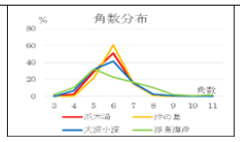
Finally, we tried to make columnar joint made of potato starch by drying the mixture of water and potato starch in a container. In addition, when drying, a non-uniform cooling condition was reproduced by applying a temperature gradient using an incandescent lamp. As a result of graphing the data obtained by dividing the resulting columnar joint by voronoi division, the ratio of the hexagons to the total ratio under all conditions was the largest. Therefore, focusing on the portion with a large temperature gradient, the unevenly heated samples has a larger area as it is closer to the heat source, and is not affected by heat when it is separated to a certain point. Furthermore, when comparing the portions close to the heat source, the unevenly heated samples showed a larger variation in the number of corners than the uniformly heated sample. From these, we thought that the uniformity of heating was related to the distribution of the number of squares.

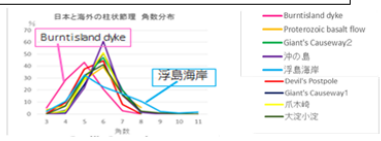
From these experiments, we found that the columnar joints had more hexagonal distributions in thicker rocks, and a greater variation in the number of corners in thinner rocks and dikes. We also found that the cooling temperature becomes uneven due to the rock and dike, and the area also varies. In addition, the same could be reproduced with potato starch.

Keywords: columnar joint, high precision 3D model

Ⅰ、浮島海岸の柱状節理を昨年の柱状節理のデータと比較



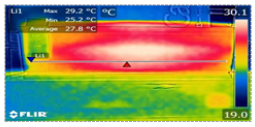

Ⅱ、海外の柱状節理のデータを日本の柱状節理のデータと比較



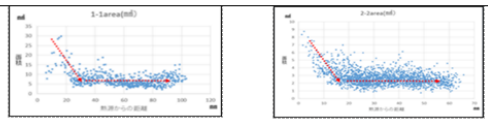

Ⅲ、片栗粉実験で白熱電球の位置条件をまとめた表

| | 1－1 | 2－2 | 3－2 |
|---|---|---|---|
| 片栗粉 | 300g | 300g | 300g |
| 白熱球の位置 | 熱源を端に置いた場合 | 熱源を中央に置いた場合 | インキュベータで均一に40度で加熱した場合 |

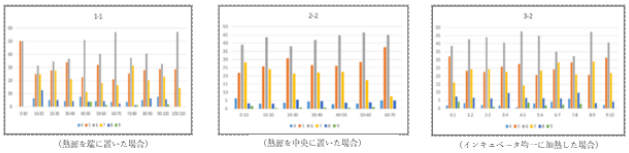
Ⅲ、片栗粉実験で使用したサーモグラフィーカメラの写真（熱源を中央に置いた場合）横から撮影




Ⅲ、片栗粉実験で得たデータを、縦軸を面積、横軸を熱源からの距離としてグラフ化した
左側　（熱源を端にした場合）　右側　（熱源を中央とした場合）




Ⅲ、片栗粉実験で得たデータを、縦軸を全体の個数に対する割合、横軸を熱源からの距離としてグラフ化した




（熱源を端に置いた場合）　（熱源を中央に置いた場合）　（インキュベータ均一に加熱した場合）