

3D LASERSCANNING OF A SEMI-ELLIPSOID PHONOLITE BALL FROM HOHENTWIEL – EVIDENCE FOR AN IMPACT

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Introduction: The phonolith plug dome Hohentwiel is located nearby the Lake Constanze in south Germany. The aim of this 3D scanning is to try to find one more piece of evidence for an impact, together with already published chocked quartzes and shatter cones from Hohentwiel (Münchberg, Wieland 2014)

Calculation: The scanned phonolite semi-ellipsoid ball has rough dimensions of 95 × 120 mm with a thickness of 45 mm. Each scan in 5 different location by HDS7000 Laser Scanner, generates it's own point cloud with its own coordinate system. The generated point clouds have been collected together and performed a successful registration with Cyclon Software. The registration error is 1-3 mm. The registered point cloud has been exported to Cloud Compare software for using SOR filter (Statistical Outlier Removal). Using Matlab software, the measured point cloud has been fit and compared with an semi-ellipsoid, which is considered as perfect symmetry for the scanned point cloud of the ball. These are the equation and the parameters of the Semi-ellipsoid which best fit the point cloud using try and error:

$$\frac{(X - x_c)^2}{X_R^2} + \frac{(Y - y_c)^2}{Y_R^2} + \frac{(Z - z_c)^2}{Z_R^2} = 1 \quad Z > 0$$

x_c , y_c and z_c are the center of the ellipsoid.
 X_R , Y_R and Z_R are the radii in the corresponding directions.

The table below shows the parameters for the semi-ellipsoid that is considered as the best fit of the phonolite ball point cloud:

| X_c | Y_c | Z_c | X_R | Y_R | Z_R |
|--------|--------|-------|-------|-------|-------|
| -0.981 | 0.6995 | 0.0 | 0.070 | 0.024 | 0.077 |

The maximum deviation between the measured point cloud and a semi-ellipsoid with a perfect symmetry is about 17 mm inside and about 4 mm outside of the semi-ellipsoid with perfect symmetry.

Discussion: Reasons for highest velocity of rotation of the phonolithe ball are: The phonolite ball is, in contrast to volcanic balls, nearly perfect ellipsoid. Less weathered gas bubbles of the ball from Hohentwiel show elliptical shape. They are accumulated at the surface along the biggest plane of symmetry.

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References: [1] DGM. AB. R. n.d. *CloudCompare User's Manual for version 2.1. s.l.:* <http://www.danielgm.net>. [2] Geosystems, L., 2011. *HDS7000 Product Specifications*. Heerbrugg: Leica Geosystems. [3] Geosystems, L., 2012. *HDS7000 User Manual*. Heerbrugg: Leica Geosystems. [4] LLC. L. G. H., 2008. *HDS and Cyclone Training Course*. Munich: Leica Geosystems HDS LLC - European Office. [5] Münchberg, C. Wieland, F. 2014. *Hohentwiel: möglicher Meteoritenkrater - unpublizierte Funde* s.l.: <http://www.oberschwaben-portal.de>. [6] Sayas, F., 2010. *Learning MATLAB: tips & examples (PG-13)*.