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The endogenic origin of the Urach-Steinheim-Ries field

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Abstract

In this thesis the origin of the Ries and the Steinheim craters is discussed. Since both the ancient astenospheric uplift and tracks of the mantle plume under the Urach diatremes field are discovered [18], we assume that the hotspot of the plume could have moved from Urach towards the East through the Steinheim-Ries basin in Miocene. It could have been the reason for the craters origin in the same places.

1. Introduction

The Ries/Steinheim basin lies in the center of the European Volcanic Province (EVP) that extends from the Central Massif in France to the Pannonian basin in eastern Europe [4]. Further, the Ries/Steinheim basin, as well as the diatremes fields of Urach to the West and the Bohemia to the East from this basin, are parts of the common aulakogen, i.e., an ancient rift arch [11]). Both the ancient astenospheric uplift and tracks of the mantle plume under the Urach field are discovered [9, 18]. In fact, continental hotspots correlate with rifts and points of intersection/junction rifts and faults. The linear fault between the Urach field and the Ries crater is parallel to both the tectonic rampart of basis and to the cliff line of the ancient ocean Tethys [3]. Moreover, the Ries crater is located at the junction of two magmatic zones, namely, the tectonic anticline fold of the Tauber-Ries axis and the shoreline of the Danube flexure in the Schwab Alps [3]. Hence, we assume that the hotspot of the mantle plume could have moved from the Urach diatremes field to the Steinheim-Ries basin and further to the Bohemia-Carpathia in the East.

2. Effects of the hotspot moving

The high flux of the mantle-derived convection magma led to a high flux of heat, hot geotherms and the diapirism in the Urach-Steinheim-Ries structure. Thus, calcite in Ries glasses could be either as primary or as the melilite metamorph like in Urach diatremes. Such metamorphism is the property of olivine milililites, associated with kimberlites [6]. The origin of both autolites and splash-lapilli in the craters are explainable by means of compress gases rapid penetration into a free space above degassed magma [6]. Note that the rims of Ries suevites are similar to the glassy rims of melilitite cores from Urach lapilli tuffs. Probably, this is the indicator their similar mechanism of origin. Rims could have formed either by the cooling of magma analogous to rims in kimberlite autolites [6] or later during the hot convection by ignimbrite currents in the crater [16]. Hence, these effects originated not from an impact, but from endogenic activity.

3. The Steinheim crater

The structure of the Steinheim crater remained intact. However, in contrast to other craters, the Steinheim crater does not possess an ejecta blanket. This can be neither attributed to full erosion, nor to porous surface in or around the crater [4]. The Steinheim crater has an unusual central peak (of D ~ 900 m and ~ 50 m above the basin floor), similar to a volcanic geoblem typically formed during lava eruptions. If the Steinheim crater did not originated from an impact, then both shatter cones and shock quartz are not exclusively indicators for the meteorite impacts. Hence, this supports the assumption that the interaction of shock waves with the surface is not understand yet in detail [3, 7]. In fact, shatter cones can form during atomic tests [5] as well as from gas explosions of erupting volcanoes [3]. Brittle-ductile structures well-known in the Earth's deep [2, 3, 6]. Hence, a part of the shattering deposits could have been uplifted to the surface by mantle plumes.

4. The Urach diatremes field

Reverse magnetic anomalies of volcanoes in Germany happened in the Miocene [12], that is the time when the peak in Earth's tectonic active cycles was registered [10]. Note that the second from the three Styrian volcanic events in Austria had a peak 14.74 My ago [14] which is coincided with the Ries-Steinheim craters age. In addition, compact tektite groups were found both in Austria and at the Austria-

Czech boundary. Tuff horizons in Central Europe deposited from 15.5 Ma to 13.2 Ma could have had the synchronism with the Carpathian-Pannonian volcanic field which was at that time the only active region producing explosive calc-alkaline felsic volcanism [13]. Ash OSM horizons deposited in the middle Miocene in sediments in both the Swiss Alps and in South Germany, correlate with other tephra deposits in Europa [13]. These ash OSM horizons were deposited between 15.5-13.0 Ma, the time of volcanic activity in Central Europe. Hence, chemical divergency of IMR in both the melt inside the Ries suevites and near the Ries first ring rampart [1], can be explained by recurrent endogenic fluids of different age in the Ries region. In that case the reverse remanent magnetization in Ries suevites lying under sediments with normal remanent magnetization, can be connected to one of the reverse magnetism periods at that time. Since the repeating volcanic activity of the Urach fields (20-11 My) is older than the Ries crater age (15 My) [15, 17], a hotspot moving from the Urach towards the East could have resulted in formation of the Ries crater, but not vice versa. Probably, the movement of the hotspot could have been associated with the Alps expansion in the Miocene as well.

5. Summary and Conclusions

Taking into account all arguments, we claim that the origin of both Ries and Steinheim craters is related to the hotspot moving across the EVP, rather than to an impact event.

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References

[1] Artemieva, N. et. al.: Ries crater and suevite revisited, Meteoritics and Planetary Science, Vol. 48, p. 590, 2013.

[2] Best, M. et al.: Slab-rollback ignimbrite flareups in the southern Great Basin and other Cenozoic American arcs, Geosphere, Vol. 12, pp. 1097–1135, 2016.

[3] Bucher, W.: Cryptoexplosion structure caused from without or from within the Earth?, American Journal of Science, Vol. 261, pp. 567-649, 1963.

[4] Buchner, E. and Schmieder, M.: The Steinheim Basin impact crater (SW-Germany) – Where are the ejecta?, Icarus, Vol. 250, pp. 529-543, 2015.

[5] Bunch, T. and Quaide, W.: Shock Metamorphism of Natural Materials, Mono Book Corp., pp. 285–286, 1968.

[6] Dawson, J.: Kimberlites and Their Xenoliths, Springer Press Berlin – Heidelberg - New York, 252 p., 1980.

[7] French, B.: Traces of Catastrophe, LPI Contribution no. 954, Houston, Texas, 120 pp., 1998.

[8] German, B.: The crisis of the impact paradigm and the genesis of tektites, German Verlag, Freiburg, 205 p., 2019.

[9] Hegner, E. and Vennemann, T.: Role of fluids in the origin of Tertiary European intraplate volcanism, Geology, Vol. 25, p. 1035, 1997.

[10] Hüsing, S. et. al.: Astrochronology of the Mediterranean Langhian between 15.29 and 14.17 Ma, EPSL, Vol. 290, pp. 254-269, 2010.

[11] Kopecky, L.: Relationship between phenitization alkaline magmatism, barite-fluorite mineralization and deep-fault tectonics in the Bohemian Massif, Geology Final Report, Praha, pp. 73-96, 1971.

[12] Reich, X. and Horrix, W.: Geophys. Untersuchungen im Ries und Vorries und deren Deutung, Geolog. Landesant. Geolog. Jahrb., N. 19, Hannover, 119 p., 1955.

[13] Rocholl, A. et. al.: The age of volcanic tuffs from the Upper Freshwater Molasse (North Alpine Foreland Basin), Int. Journal of Earth Sciences, v. 107, pp. 387-407, 2018.

[14] Rögl, F. et al.: The Styrian Tectonic Phase, Geophysical Research Absracts, Vol. 8, EGU10733, 2006.

[15] Schmieder, M. et al.: Considerations on the age of the Urach volcanic field, Zeitschrift Deutschen Gesellschaft für Geowissenschaften, Vol. 160, pp. 325–331, 2009.

[16] Siegert, S., Branney, M., and Hecht, L.: Density current origin of a melt-bearing impact ejecta blanket (Ries suevite, Germany), Geology, Vol. 45, pp. 855-858, 2017.

[17] Strasser, M., Höhlen der Schwäbischen Alb, SW Deutschland seit dem Miozän, Universität Stuttgart, 2011.

[18] Wilson, M. et al.: Melilitites: partial melts of the thermal boundary layer?, Contribution to Mineralogy and Petrology, Vol. 119, pp. 181-196, 1995.