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Creussen Bleaching

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Abstract

The Creussen Bleaching occurs in the Lowest Jurassic Gümbel Sandstone in the surroundings of the town of Creussen in Upper Franconia. The white bleaching of the sandstone leaves an iron oxide precipitation aureole around the borders of the permeable sandy material. Moreover, it causes decomposition of the earlier cementation of the sandstone.

This process is considered a fluid bleaching and alteration using access to the tectonic Creussen Fault Zone. Thus, it also follows this fault zone trending to the southeast with a centre around Hirschau. Its age is bracketed between end of Jurassic and early Tertiary.

This paper is a preliminary record of a bleaching core along the Northeastern Bavarian Fluid Belt.

Key words: fluid bleaching, Creussen Bleaching, Gümbel Sandstone, Creussen Fault Zone.

Kurzfassung

Creußen-Bleichung

Die Creußen-Bleichung ist im tiefsten unterjurassischen Gümbelsandstein im größeren Raum um Creußen in Oberfranken ausgebildet. Die hellweiße Bleichung des Sandsteins wird von einer Aureole der Eisenfällung rund um den klastischen Körper umgeben, die die Bereiche ausreichender Permeabilität abgrenzt. Die Bleichung wird als eine Fluidbleichung angesehen, die im Zuge der Creußener Störungszone aktiv werden konnte. Daher tritt sie auch entlang der Störungszone weiter nach Südosten hin in verschiedenen Sandsteinen auf, vor allem in einem Zentrum um Hirschau. Ihr Alter kann auf endjurassisch bis frühtertiär eingeengt werden. Die Bleichung wird auch von Sandstein-Zermürbung begleitet.

Der vorliegende Text ist ein Kurzbericht über eines der Bleichungszentren im Zuge eines Nordostbayrischen Bleichungsgürtels.

Schlüsselwörter: Fluid-Bleichung, Creußen-Bleichung, Gümbel-Sandstein, Creußen-Störungszone.

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1 Introduction

In eastern Upper Franconia tectonic overthrust of the Variscian socle to the southwest (PETEREK & ROHRMÜLLER 2010: 194) created a graben and horst edifice in its foreland. This edifice presents an interlinked fault structure striking from southeast to northwest thereby creating long and narrow fault blocks. A major long fault zone is the Creussen Fault Zone named after the town of Creussen (middle part of the red fault zone in Fig. 1).
It is part of a nearly 100 km long fault zone within the Franconian Fault Block Zone.

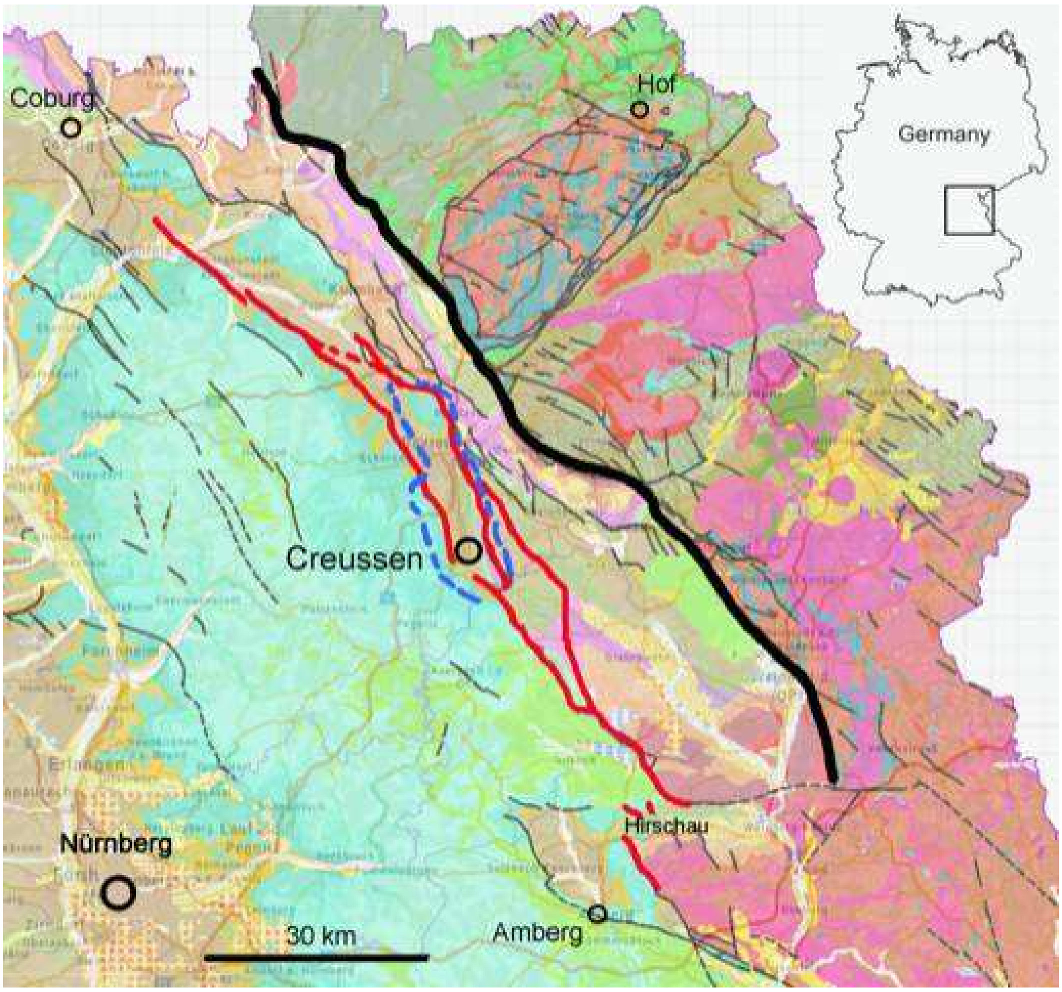

Fig. 1 Geological map of northeastern Bavaria. Blue broken lines = Creussen Bleaching area as far as investigated up to now. Thick black line = Franconian Fault. Thin black lines: faults. Red lines: NW–SE fault system as possible pathway for fluid flow of the Creussen area. Background map: Geological map of Bavaria 1: 500.000 © Bayerisches Landesamt für Umwelt, www.lfu.bayern.de.

In some of the fault blocks Lower Jurassic Gümbel Sandstone is found. This Gümbel Sandstone shows striking white bleaching (Fig. 2) that must have a certain local background. It reaches vertical thicknesses up to 15 m and a lateral extent of at least 30 km.
The bleaching feature here is called Creussen Bleaching owing to the fact that its most striking appearance can be found around the town of Creussen (Fig. 1).

Fig. 2 Bleached Lower Jurassic Gümbel Sandstone in the sand pit Forkendorf. Photo: W. Schirmer 21.05.2018.

2 Objectives

All outcrops in the Gümbel Sandstone in the area around Creussen exhibit conspicuous white bleaching (Fig. 2). The bleached area – as far as observed to date – is shown in Fig. 1. Outside this area the Gümbel Sandstone is yellow brown in color.

Inside the bleached area the bleaching is not continuous. It tapers off in areas with clay cemented sandstone or materials with reduced porosity. Those areas as well as the edges of the bleaching are marked by iron staining or precipitation of iron oxide (primarily iron oxihydroxide FeOOH).

Concerning the thickness of the bordering iron oxide aureole it is very thin in the top of the bleaching (Fig. 3), thicker at its lateral extent, and thickest at its bottom. The bottom parts of the bleaching are deeply brown with a red hue. This iron oxide cementation, thickest at the base of the alteration, also may form smaller or larger patches, pods, streaks and lenses in the midst of the bleaching area or toward their edges (Fig. 4).

Fig. 3: Bleached Lower Jurassic Gümbel Sandstone in the sand pit Freileithen. The white-black contact is the upper contact of the bleached fluifer against the fluiclude, the black sandy clay of the Bamberg Formation. On the right end of the contact, where the meter scale is positioned, the adjoining clay is involved into the iron oxide precipitation seam (red discolored clay). Foto: W. Schirmer 23.02.2014.

Fig. 4 Bleached Lower Jurassic Gümbel Sandstone in the sand pit Großweiglareuth with an intercalated band of iron oxide. Foto: W. Schirmer 17.02.2014.

Where the bleached Gümbel Sandstone adjoins an impermeable rock the precipitated iron oxide cements both the Gümbel Sandstone and the outmost adjoining rock (Fig. 3 rightmost red contact).

A further consequence of the alteration is the decomposition of the earlier cementation of the sandstone. As a result the former sandstone is now left as very weak sandstone or loose sand. This is the reason why the important sandstone occurrences in this area of northeastern Bavaria can only be exploited for sand production and not for building stones as recorded in BOGL (1936: 214).

3 Discussion

Bleaching is well known from spodic soils. This soil develops a bleached E horizon up to several decimeters in thickness (20–150 cm, SCHEFFER et al. 2002: 500). Downwards it is followed by a brown Bs horizon. It is emphasized that the dissolved iron of the spodic soil bleaching is transported downwards, partly also laterally. Thus, in places the spodic soil may appear similar to the Creussen Bleaching. However, the Creussen Bleaching differs to a spodic soil in several facts: 1. by immense vertical extension of more than 15 m, 2. by extremely broad lateral extension, some tens of kilometers, 3. by showing Bs horizon properties above the E Horizon that never develops in a spodic soil, and 4. by restricting the bleaching to distinct properties of permeability within the sandstone. – The same applies for acid bleaching below a peat layer.

Thus, it follows that the Creussen Bleaching cannot be a soil formation. It is considered to be a fluid bleaching, which also produces the accompanying iron oxide precipitation. Applying the terms aquifer and aquiclude to fluids, the Gümbel Sandstone acts as fluifer. Fluiclude overlying the Gümbel Sandstone is the dark grey clayey Bamberg Formation in a marginal marine development. Bleaching appears to be strongest below the fluiclude. This points to buoyant chemically reducing fluids. Downwards bleaching decreases in favor of iron precipitation in different forms from coloring to cementation.

Similar alteration of sandstones is recorded from other areas, for example by HEINE (1970) from Buntsandstein in Hessen, BEITLER et al. (2005) from the Lower Jurassic Navajo Sandstone or DUNCAN et al. (2017) from Cretaceous Baseline Sandstone both in southwestern USA.

The fluid flow pathway may be given by tectonic fault lines (AGEMAR et al. 2017: 288, HOPPE et al. 2015). The Creussen area offers pathways by the near Asslitz–Motschenbach–Saas–Creussen–Kirchenthumbach–Freyung fault system with a length of almost 100 km (red lined in Fig. 1).

4 Age of the Creussen Bleaching

Where the bleached sandstone has been partly removed by erosion, bleaching is masked by a saprolite that overprints the Creussen Bleaching. This indicates that the Creussen Bleaching ended prior to the saprolite formation. Moreover, it indicates that the Creussen Bleaching is fossil.

It has to be younger than the bleached fluifer and younger than the fluiclude. In the Creussen area both fluifer and fluiclude are of Early Jurassic age. In the Hirschau area the fluifer is of Middle Jurassic and even Upper Cretaceous (Turonian) age. Moreover, it is older than the saprolite formation, which is roughly of Tertiary age.

The bleaching obviously follows great tectonic lines, in this case the Creussen Fault Zone. This fault zone belongs to the Franconian Fault Block-Zone in the foreland of the Franconian Fault. The age of this large fault belt is dated between Lower Cretaceous and early Paleogene (PETEREK & ROHRMÜLLER 2010: 194). This period could be appropriate for the timing of the fluid flow.

5 Conclusion

In northeastern Bavaria a conspicuous bleaching is present, here called Creussen Bleaching. The bleaching may be due to fluid flow-driven alteration. The alteration comprises bleaching by iron oxide solution and iron oxide precipitation at the boundaries of the bleaching, primarily at the base of the bleached area. The fluid flow pathway likely uses tectonic lines. It spreads around Creussen within the Gümbel Sandstone (Bayreuth Formation) of Lowest Jurassic age. The clayey Bamberg Formation of likewise Lower Jurassic age serves as fluiclude for this fluifer. Thus, the age of the Creussen Bleaching around Creussen is bracketed by the Sinemurian Bamberg Formation and the Tertiary saprolite.

The Creußen Bleaching is part of a Northeastern Bavarian fluid belt. Another bleaching centre of this belt is the Hirschau Bleaching farer towards southeast, where it is observed in sandstones of different ages including Middle Jurassic sandstone.
According to the major tectonic activity of this area the fluid flow may have occurred between Lower Cretaceous and early Paleogene.

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7 References

AGEMAR, T., HESE, F., MOECK, I. & STOBER, I. (2017): Kriterienkatalog für dei Erfassung tiefreichender Störungen und ihrer geothermischen Nutzbarkeit in Deutschland. – German Journal of Geology, 168 (2): 285–300.

BOGL (1936): Bayerisches Oberbergamt, Geologische Landesuntersuchung [Hrsg.]: Die nutzbaren Mineralien, Gesteine und Erden Bayerns. 2: Franken, Oberpfalz und Schwaben nördlich der Donau. – 511 S., 1 Krt, 62 Abb., 25 Taf., 2 Krttaf. (mit Nachträgen zum Bd. 1), München.

BEITLER, B., PARRY, W.T., & CHAN, M.A. (2005) Finger-prints of fluid flow - chemical diagenetic history of the Jurassic Navajo Sandstone, Southern Utah, U.S.A. – Journal of Sedimentary Research, 75: 547-561.

DUNCAN, C.J., CHAN, M.A. & BOWEN, B.B. (2017): Diagenetic mineral mapping in the Cretaceous Baseline Sandstone, Southern Nevada from combination of Landsat, UAV, and reflectance spectral data. – Geological Society of America, Abstracts with Programs, 49 (6).

HEINE, K. (1970): Die Bleichung der Sandsteine bei Marburg/Lahn – eine hydrothermale Bildung. – Notizblatt des Hessischen Landesamtes für Bodenforschung zu Wiesbaden, 98: 198–202, pl.11–12.

HOPPE, A., KOŠTÁK, B, KUHN, G., LEHNÉ, R, SIMONS, U & STEMBERK, J. (2015): Rezente Bewegungen an den Hauptrandverwerfungen im Nördlichen Oberrheingraben. – Jahresberichte und Mitteilungen des Oberrheinischen Geologischen Vereins, N.F. 97: 321–332.

PETEREK, A. & ROHRMÜLLER, J. (2010): Zur Erdgeschichte des Fichtelgebirges und seines Rahmens. – Der Aufschluss, 61: 193–211.

SCHEFFER, F. & SCHACHTSCHABEL, P. (2002): Lehrbuch der Bodenkunde. – 15. Aufl.: 593 p., Heidelberg (Spektrum).