Zeitschrift: Bulletin de la Société Fribourgeoise des Sciences Naturelles = Bulletin der Naturforschenden Gesellschaft Freiburg

Herausgeber: Société Fribourgeoise des Sciences Naturelles

Band: 114 (2025)

Artikel: Raw materials and roof tiles from the "Mechanische Backsteinfabrik Zürich" : a chemical, geological and historical analysis

Autor: Maggetti, Marino / Galetti, Giulio

DOI: https://doi.org/10.5169/seals-1092163

Raw materials and roof tiles from the «Mechanische Backsteinfabrik Zürich» - a chemical, geological and historical analysis

Marino Maggetti and Giulio Galetti
Department of Geosciences, University, CH-1700 Fribourg

Im Rahmen dieser Arbeit wurden 24 Dachziegel der «Mechanische Backsteinfabrik Zürich» in Zürich/Wiedikon chemisch und mineralogisch-petrographisch untersucht. Die Geschichte dieses Betriebes und der benachbarten Backstein- und Ziegelfabriken Albishof und Heurieth wird summarisch vorgestellt. Das Probenmaterial besteht aus Zufallsfunden an der Oberfläche, deren Zuweisung auf Grund der gestempelten Firmenbezeichnung eindeutig ist. Formal konnten drei Ziegeltypen (Einfach-Falzziegel, Herz-Einfachfalzziegel und Mulden Doppelfalzziegel) unterschieden werden, die sich auch bezüglich ihrer Stempel unterscheiden. Die gestempelten Jahrzahlen liegen zwischen 1885 und 1915. Die Dachziegel bestehen aus einem Gemisch von mindestens zwei quartären Ablagerungen: kalkreiche Hanglehm-Mergel von der Nordseite des Uetlibergs und kalkärmere Ablagerungen des Sihlfeldes (Herdern). Die makroskopischen und mikroskopischen Untersuchungen zeigen unterschiedliche Grade der Durchmischung. Die in schriftlichen Quellen dokumentierte Sandzugabe passt gut zu den deutlich höheren SiO_2*-Gehalten der jüngeren Ziegel. Die 24 Zürcher Ziegel unterscheiden sich chemisch von den bisher untersuchten 372 schweizerischen Dachziegeln.*

Ce travail présente les résultats d'analyses chimiques, minéralogiques et pétrographiques effectuées sur 24 tuiles issues de la «Mechanische Backsteinfabrik Zürich» à Zürich/Wiedikon. Un bref aperçu historique de cet établissement et de deux autres situés à proximité (Albishof, Heurieth) est présenté. L'ensemble étudié se compose de découvertes fortuites en surface, qui sont clairement attribuées à la tuilerie en fonction des marques portant le nom de l'entreprise. Du point de vue de leur forme, trois types de tuiles ont été recensés (tuiles simples emboîtables, tuiles simples emboîtables à cœur et tuiles creuses à double emboîture), qui diffèrent également par leurs estampilles. Les années estampillées se situent entre 1885 et 1915. Les tuiles sont constituées d'un mélange *d'au moins deux dépôts quaternaires : des marnes de pente du côté nord de l'Uetliberg et des dépôts moins carbonatés du Sihlfeld (Herdern). Les examens macroscopiques et microscopiques montrent divers degrés de mélange. L'ajout de sable documenté dans les sources écrites correspond bien aux teneurs en* SiO_2 *nettement plus élevées des tuiles plus récentes. Les 24 tuiles de Zürich diffèrent chimiquement des 372 tuiles suisses examinées jusqu'à présent.*

In this work, 24 roof tiles from the «Mechanische Backsteinfabrik Zürich» tilework in Zürich/Wiedikon were chemically and mineralogically-petrographically examined. The history of this and two neighbouring factories (Albishof, Heurieth) is presented in summary. The sample material consists of random finds on the surface, which can clearly be assigned to the factory based on the company name. Three different tile types (Straight single interlocking tile, heart single interlocking tile and hollow double interlocking tile) were found which differ by their marks. The stamped years range from 1885 to 1915. The roof tiles consist of a mixture of at least two Quaternary deposits: slope loams from the north side of the Uetliberg and less calcareous deposits from the Sihlfeld (Herdern). The macroscopic and microscopic studies show variable degrees of mixing. The addition of sand documented in written sources fits well with the significantly higher SiO_2 *contents of the younger tiles. The 24 Zürich roof tiles differ chemically from the 372 Swiss roof tiles examined so far.*

Introduction

The raw materials for the 19th and 20th century Swiss and tile industries are chemically, mineralogically and technologically well studied – see the seminal paper of MUMENTHALER ET AL. [MUM97] which provides a comprehensive overview of the clayey materials used in these Swiss brick and tile factories. In contrast, there are far fewer chemical analyses of Swiss bricks and tiles. Some papers were addressed to Roman [MAG93, MAF93, GIA01a, GIA01b, GIA05, MAG01, WO04, MEY06] and Medieval [WO99, WO02a, WO02b, WO03] samples. Few chemical analyses of 19th to 20th century Swiss brick and tile bodies are contained in some reports [IBE71, IBE72, PET73, PET78, MEY84, FÜR93, FÜR98, MUM95, CUA00]. The present study follows three earlier studies [MAG20, MAG22, MAG23]. In 2020, 129 tiles from the brick- and tileworks of Corbières, Düdingen and Le Mouret, all situated in the Canton of Freiburg, were examined for their chemical, mineralogical and petrographical composition (Fig. 5.1). The 2022 paper focused on the same aspects of 148 roof tiles from nine Bernese tileworks. In 2023, 95 roof tile analyses from the Allschwil and Laufen factories were discussed.

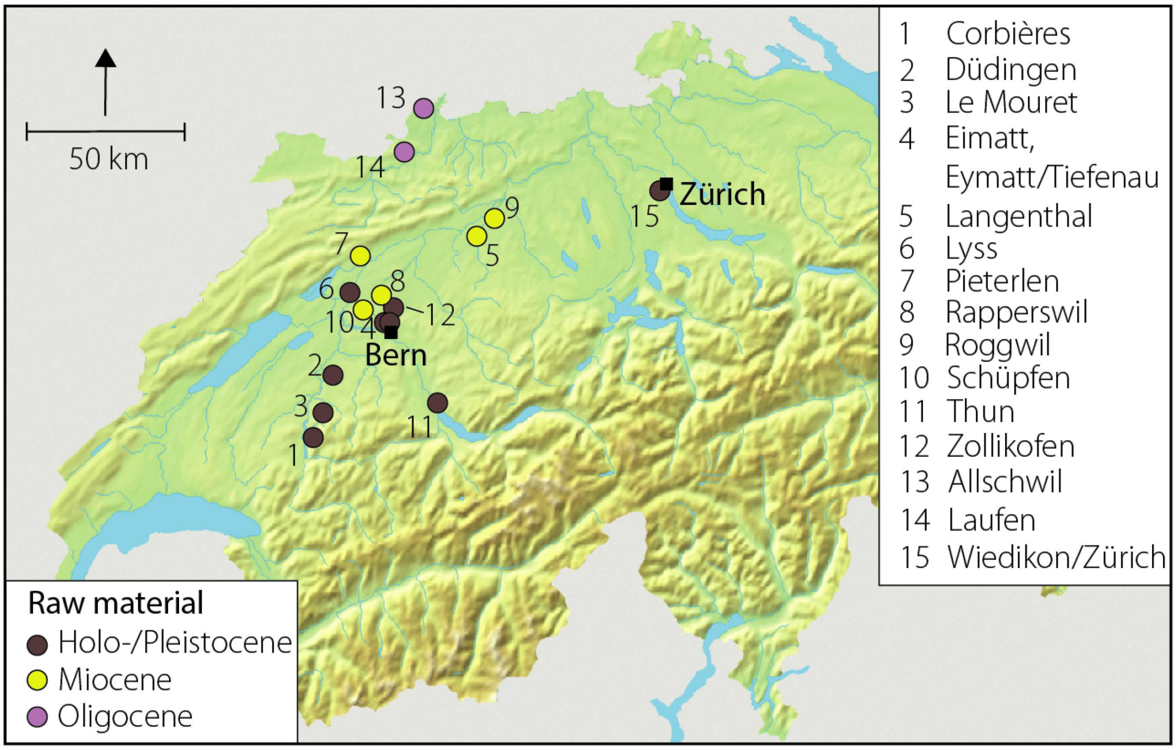


Figure 5.1: *Localization of the previously studied Swiss brick- and tile-factories [MAG20, MAG22, MAG23] and of the Zürich factory. The three main raw materials are highlighted with different colours. Map © Wikipedia. Graphic editing* MARINO MAGGETTI.

This study deals primarily with brick- and tileworks that were established in the political municipality of Wiedikon from the 1860s onwards (Fig. 5.2), specifically the roof tiles of the «Mechanische Backsteinfabrik Zürich» [Mechanical brick factory Zürich]. In 1893, Wiedikon lost its status as a municipality when it was incorporated into the city of Zürich [IL15].

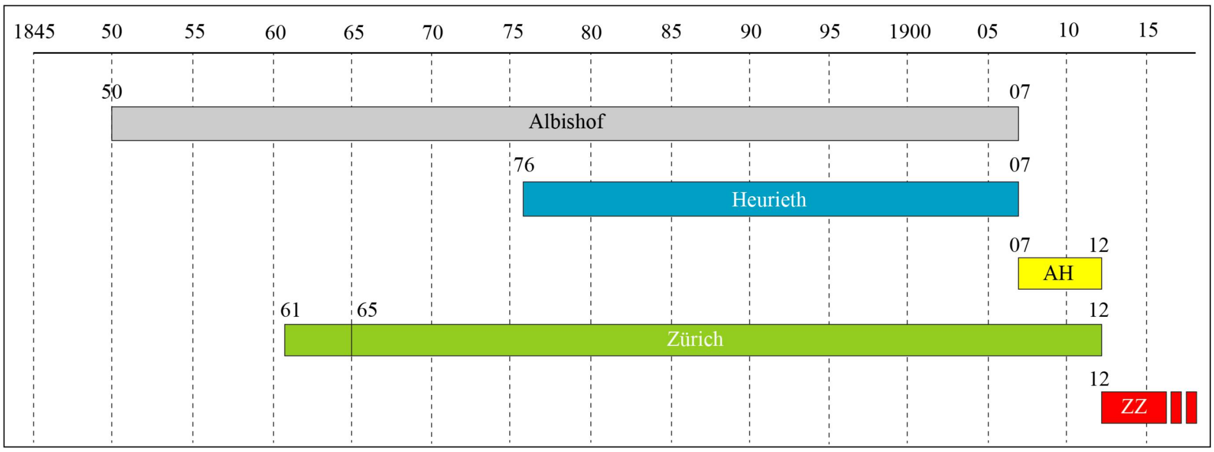


Figure 5.2: *Production periods of the three mechanical brick and tile companies in Wiedikon/Zürich. AH = Albishof/Heurieth, ZZ = Zürcher Ziegeleien. Drawing* MARINO MAGGETTI.

Short histories of the brick and tile factories in Wiedikon / Zürich

This section is primarily based on printed sources and published specialist literature [ET77, FY23]. Other important sources were the commemorative publications to the 50th [GU62], 75th [ZU87] and 100th [LU12] anniversaries of the «Zürcher Ziegeleien». The following is limited to the second half of the 19th century up to around 1912, as the company «Zürcher Ziegeleien» was created.

Southwest of the city of Zürich, on the northeastern slopes of the hilly Uetliberg, stretches a vast zone of clayey deposits that have been exploited by many hand-made brick- and tileworks since the Middle Ages (NZZ 29.03.1899, 04.04.1899, 09.04.1899, 17.4.1899, 25.05.1924, 28.05.1924). As shown on the BREITINGER map [BR94], this region south of the village of Wiedikon consisted in 1804 of meadows, fields, trees and a few houses (Fig.5.3). The village itself appears to be a few loosely grouped farmhouses and does not yet have a church. South of the village name a small, but prominent oval hill, planted with vineyards on both sides can be noted. A closer inspection reveals that the cartographer has inserted signs in some places that may be interpreted as edges of clay pits, see the three red bordered areas in the enlarged and in-

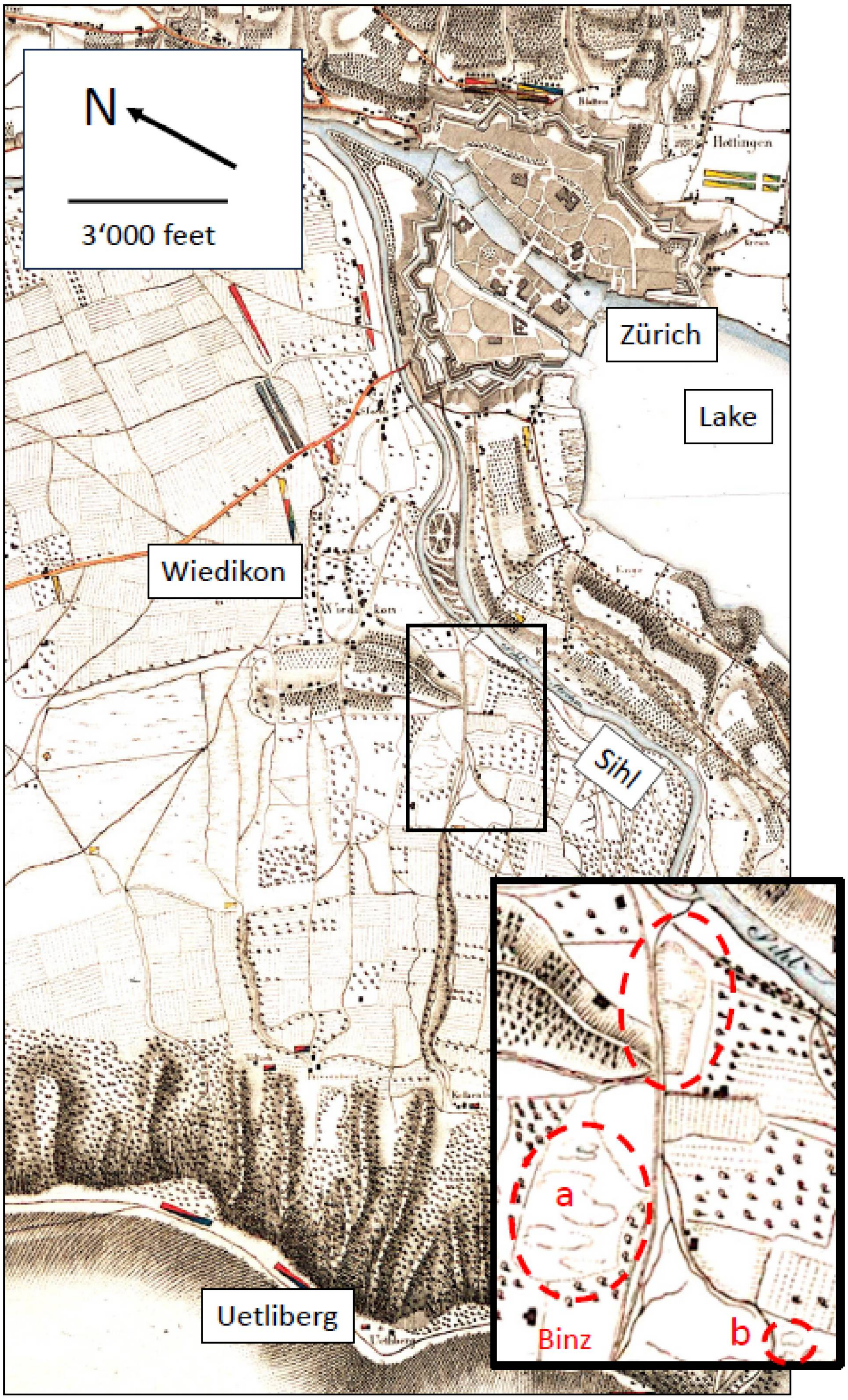
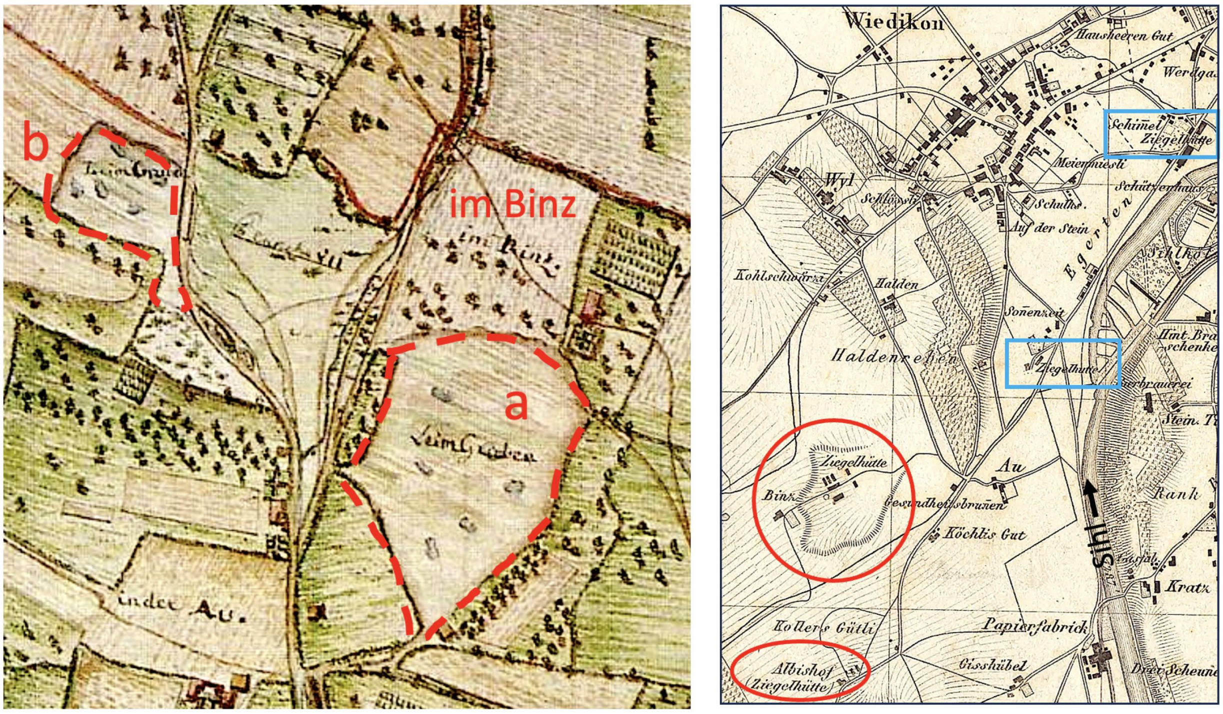


Figure 5.3: *Excerpt from the map «Plan de la Ville et des Environs de Zürich» by* D*AVID BREITINGER [BR94]. Inlay: Enlarged section with clay extraction sites close to the «Binz» farm house (a, b). Graphic editing MARINO MAGGETTI.*

serted section of this figure. Both areas «a» and «b» are also clearly labeled as such, i. e. «LeimGruben» [Clay pits], on the slightly older manuscript map of Hans Caspar Hirzel [HI85, ET77, 68], see figure 5.4A.



(A) (B)

Figure 5.4: **(A)** *Detail of the manuscript map of* HANS *C*ASPAR *H*IRZEL *(1785-1790) with both clay pits a, b as in the previous figure. Orientation: South. Graphic editing* MARINO MAGGETTI. **(B)** *Detail of the map of [*RUDOLF*]* GROSS *(ca. 1860) with two traditional hand brick/tile factories (Blue rectangles) and two mechanical brick/tileworks (Red circle and ellipse). Graphic editing* MARINO MAGGETTI.

A map from around 1860 shows the impending upheavals in the brick-making industry on Wiedikon territory (Fig. 5.4B). In addition to two traditional hand brickworks in the vicinity of the Sihl river, outside of the clay deposits, which only consist of one main building, two new mechanical brickworks have been installed further south on the clay deposits: a multi-building factory with a circular kiln (Small circle in fig. 5.4B) in its large clay pit at «Binz» and another at «Albishof». Interestingly, the cartographer made no distinction between the two factory categories, labelling all four with the same name «Ziegelhütte» [brickworks]. The northern hand brickwork is the one at «Schimmel» or «Schimmelgut» (In activity 1597–1891; [ET77], 160–163), the southern the «Sonnenzeit» brickwork (1516–1866; [ET77, 152-155]).

From the mid-19th century onward, even more mechanical brick and tile factories settled directly on the important clay deposits of the then municipality of Wiedikon (Fig. 5.5 & 5.6). With such mechanized brick and tile works, it was possible to produce huge quantities of bricks and tiles more easily and cheaply as in the older hand-made works. Such industrial capacities were necessary given the enormous construction activity in the city of Zürich and neighbouring municipalities from the middle of the 19th century onwards, which required vast quantities of bricks and tiles.

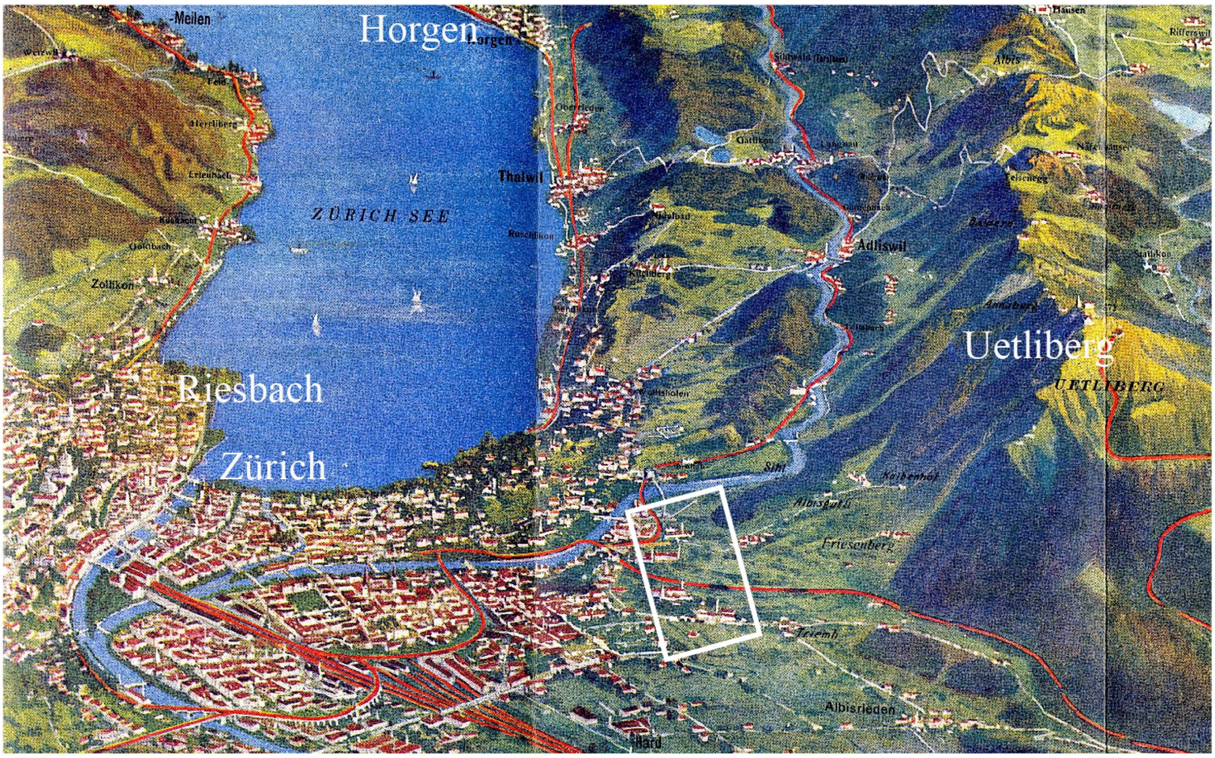


Figure 5.5: *Detail of a birds-eye view [MA13]. The settlement area of the city of Zürich and the four mechanical brickworks (white rectangle) at the northeastern foot of the Uetliberg are clearly visible. Red lines = railways. Original width* 25 cm. *Private collection. Scan* Marino Maggetti.

The hand-made brick and tile factory Bockhorn

A 1881 map shows a traditional hand-made brick- and tilework, namely that of the Bockhorn family south of «Schimmel» (Fig. 5.6, rectangle 1), which produced bricks and tiles from 1739 onwards [ET77, 23–27, 149]. As already mentioned, there used to be since Medieval times many other tileworks in Wiedikon (NZZ 05.04.1925, 27.04.1925; [ET77, 32–35, 148–166]) and the «Schimmel» tilework was operating since 1597. In 1883, Albert Bockhorn was the owner of the company that produced lime and tiles (SHAB 05.06.1883, 653). The plant was closed 1891. In 1923, the property was acquired by the city of Zürich. In Switzerland, the tile production was done since Roman times everywhere entirely by hand until the last decades of the 19th century and took place normally as close as possible to the extraction site and the sales market [HE93, KA99, BE04, HU15]. On the other hand, firewood was

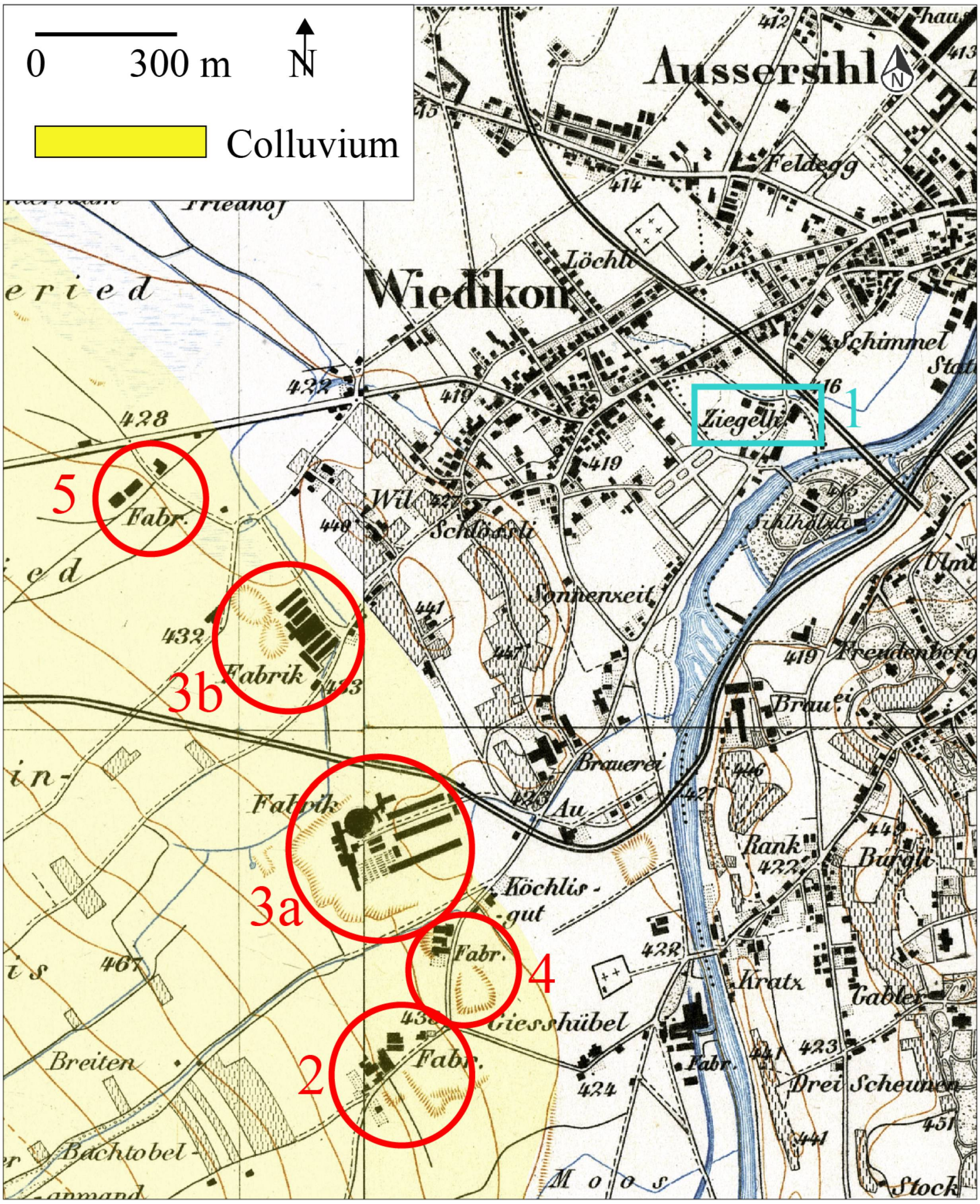


Figure 5.6: *Brick and tile factory buildings and open pits on an enlarged section of the 1881 first edition of the [Topographic Atlas of Switzerland to the scale of the original mappings] (so-called* SIEGFRIED *atlas) map 1:25'000 (sheets 160 Birmenstorf and 161 Zürich). 1 = Bockhorn, 2 = Albishof, 3a = Binz, 3b = Tiergarten, 4 = Bodmer, 5 = Heurieth. Colluvium («Uetliberg loams») according to* PAVONI ET AL. *[PA92]* © MARINO MAGGETTI.

also an important location factor, as exemplified by the Medieval brickworks of Wiedikon which settled along the Sihl River, on which the enormous quantities of firewood could be floated directly to the factories respectively the kilns. This was also the case for the «Bockhorn» factory. The clay from the clay pits as shown in figure 5.3 was mined from spring to autumn, cleaned, kneaded, mixed with water, and left to rest over the following winter, which made it finer-crumbly. The following spring, the tile makers pressed the material into a mold and formed it into flat roof tiles, which were air-dried in barns for up to three months and then fired at maximum temperatures of approximately 1000 °C. In a well-staffed factory, a team consisted of three people: the clay carrier, the molder (stringer), and the tile remover [BE95, 126]. With this efficient deployment, one team was able to produce about 800 to 1'000 tiles per day. For comparison: after 1870, a mechanical brick and tile factory delivered 25'000 bricks (or tiles) daily [ET77, 145].

The mechanical brick and tile factory «Albishof» (1850–1912)

The first mechanical tile factory was built by Fritz Diener-Bachmann from Männedorf [GU62, 6] in 1850 in the Albishof region (Fig. 5.4B; Fig. 5.6, circle 2) on the Uetliberg road [OR01]. The company statutes were adopted on March 08, 1867 (SHAB 26.06.1883). In 1880, she bore the title «Blattmann R.» (DE 12.06.1880). Three years later, the name was changed to «Ziegelei Albishof» (SHAB 26.06. 1883), 1885 to «Ziegelei Albishof in Wiedikon bei Zürich» (SHAB 26.08.1885), and 1892 to «Mech. Ziegelfabrik Albishof» (SHAB 26.2. 1892, 1099). A ring kiln was installed 1886. In 1893, the company renamed itself «Mechanische Ziegelfabrik Albishof», operating now a second factory very close to the first in «Giesshübel», which had been built in 1892. The company received a 1$^{\text{st}}$ class diploma at the cantonal trade exhibition in Zürich in 1894 (NZZ 20.08.1894). The factory grew to a major plant with 80 to 100 workers employed year-round (ISHZ 14.07.1894, 212). She merged 1907 with the Heurieth tileworks to form the new company «Ziegeleien Albishof-Heurieth» in Zürich (SHAB 10.05.1907, 1349). The management's proposal to the administration of the «Mechanische Backsteinfabrik Zürich» for a fusion (NZZ


1385. Dampfziegelei Heurieth, Aussersihl, Ziegelwaarenfabrik.
Hand- und Maschinen-Steine für gewöhnliches und sichtbares Mauerwerk — Dachziegel und Falzziegel — Formsteine.* Siehe Gr. 18 *c*.

1413. Mechanische Backsteinfabrik Zürich.
Backsteine — Verblendsteine, weisse und rothe — Profilsteine — Kaminsteine — Drainröhren — Ventilationsröhren — Hourdis zu Gewölben — Dachziegel — Falzziegel — Firstziegel. Siehe Façade, Terrasse und Bedachung am Keramik-Pavillon.
Productionsfähigkeit: 14 Millionen Stück jährlich. Drei Ringöfen. Siehe Façade, Terrasse und Bedachung am Keramik-Pavillon und die Falzziegel auf der landwirthschaftlichen Abtheilung Gr. 26 *VII*. Siehe Gr. 18 *c*.

Figure 5.7: *Excerpts from the catalogue of the fourth Swiss National Exhibition in Zürich 1883 [HAR83, 108, 110].*

15.04.1912) was accepted at the respective general meetings on June 1, 1912 (SHAB 13.05.1912, 871 and 872), and the new company took the name «Zürcher Ziegeleien» (NZZ 14.09.1912).

The «Dampfziegelei Heurieth, Aussersihl» (1875–1939)

The steam brick and tile factory «Dampfziegelei Heurieth, Aussersihl» was another newly founded mechanical brickworks in Wiedikon (Fig. 5.6, circle 5). The year of foundation is unclear: 1875 [ET77, 143], 1876 [OR01] or 1877 (LS 06.03.1904, advertisement). Initially only three brick types were produced (ZF 17.08.1877). The factory received a diploma at the Swiss National Exhibition in Zürich 1883 (Group 17, Ceramics and Cement Industry) for its very resistant tiles to pressure and water (SBZ 25.08.1883; GR 28.05.1890). The exhibition catalogue [HAR83, 108] lists the types of bricks and roof tiles produced in 1883 (Fig. 5.7). In 1887, a 10-year guarantee for roof tiles was advertised (NZZ 06.03.1887). The factory produced 1889 2.6 and 1890 2.5 million bricks and tiles (NZZ 30.04.1890). Production reached 4 million units in 1894 (ISHZ 14.07.1894). A 1st class diploma was awarded to the factory at the cantonal trade exhibition in Zürich in 1894 (NZZ 20.08.1894). In the same year, a new kiln with a 40-meter-high chimney was built (ZO 22.08.1894). Thanks to the new facilities, Heurieth was able to produce over 8 million pieces in 1898 (CSZ 11.03.1899). 9 million pieces were delivered in 1903 (LS 06.03.1904 advertisement). There are isolated references to the amount of shareholder dividends in the daily press (Tab. 11.2): they were mostly in the single-digit range (around 5%) and rarely reached 10% (1896) or a maximum of 12% (1897, 1898).

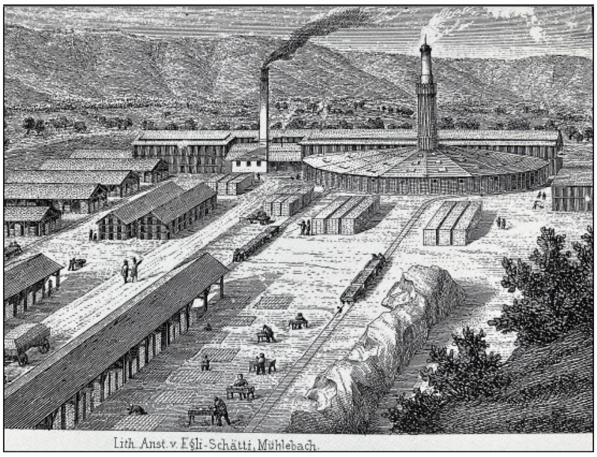
At the general meeting on May 10, 1907, it was decided to sell the company respectively to merge it with the «Mechanische Ziegelfabrik Albishof» in Zürich 3 (NZZ 29.04.1907; SHAB 25.02.1908). The capital of the mechanical Albishof factory amounted to 600'000 CHF, that of the Heurieth steam factory to 222'000 CHF. The former bought the steam company Heurieth and gave its shareholders three shares of CHF 500 each for one Heurieth share of CHF 1'000. She took a new name «Ziegeleien Albishof-Heurieth» in Zürich and increased its share capital to 1 million CHF by issuing 800 new shares of 500 CHF each (NZZ 13.05.1907).

In 1939 the production ceased and the clay pits and factory facilities were sold to the city of Zürich [ET77, 143].

The factories «Binz» (1861 – 1912) and «Tiergarten» (1875 – 1974) of the companies «Mechanische Backsteinfabrik Zürich» (1861 – 1912) and the «Zürcher Ziegeleien» (1912 – today)

In 1861, the company Frehner & Co. founded a mechanical brick factory in the area «Binz» (Fig. 5.4B; fig. 5.6, circle 3a) which was to go into production in May of the same year (BZ 25.02.1861, [OR01]). Its name was apparently «Mechanische Backsteinfabrik in Wiedikon» (ZF 25.04.1862). In 1862, the facilities were featured in a newspaper article: a steam-powered press produced approximately 25’000 bricks daily, which were dried at about 40 °C using the kiln’s waste heat. The circular kiln, heated with hard coal and slate coal, could fire 35’000 bricks per day (NZZ 01.05.1862). This circular kiln appears as a black dot in figure 5.6. Undated engravings show the industrial plant in its early years: In the foreground, the factory buildings with the round kiln and its high chimney appear in a still rural, tree-lined environment that stretches to the foot of the Uetliberg, which rises prominently in the background (Fig. 5.8).

On May 1, 1865, the company was converted into the stock corporation «Mechanische Backsteinfabrik Zürich» [Mechanical brick factory Zürich] (NZZ 07.04.1866). From June 1 to December 31, 1865, 2.9 million bricks were produced and



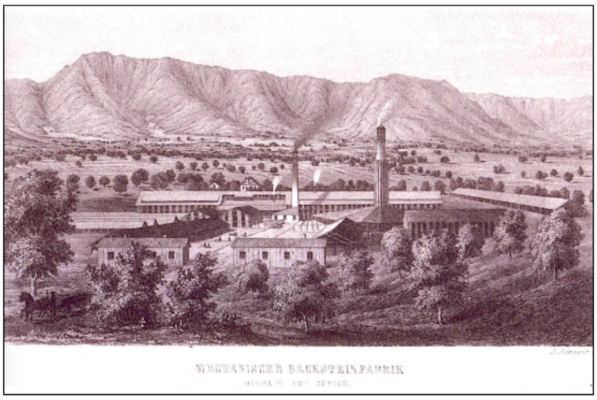


Figure 5.8: *Buildings of the mechanical brick factory «Binz» in its early days. In the background the Uetliberg hills. Above: The drying halls and the impressive round kiln with the central chimney are clearly visible. The rectangular chimney on the left belonged to a steam engine [ET77, plate 24]. Undated engraving of the* Lith. Anst. V. Egli-Schätti *in Mühlebach (Excerpt from* Zürcher Ziegeleien *[ZU87]). Below: Undated steel engraving by* Rudolf Ringger *(1841-1908), probably 1861 [ET77, plate 24]. The factory buildings, including both chimneys, are shown from a slightly different perspective as above. Excerpt from https://www.ortsmuseum-wiedikon.ch/ortsmuseum/neujahrsblaetter (accessed 24.04.2023).*

sold to construction sites in Zürich, as well as abroad (e.g. Aarau, Olten, Biel, Bern, and Thun). Approximately half a million bricks were delivered for the water supply reservoir of the city of Basel (NZZ 14.04.1866). With advertisements in Central and Western Switzerland, the factory recommended «[...] den Architekten, Baumeistern und Bauunternehmern ihre gut gebrannten, kalkfreien und aus dem besten Thon geformte Backstein, sowohl massive Handsteine als durchlöcherte Maschinensteine in verschiedenen Dimensionen» [its well-fired, lime-free bricks made from the best clay to architects, builders and contractors, both full and perforated machine-made bricks in various dimensions] (DB 25.02.1867, TWB 09.03.1867). In 1868, in addition to the previously produced red bricks, white bricks were also advertised, which, due to their weather resistance, did not require plastering and were ideal for churches, school buildings, etc. In Western Switzerland, bricks were delivered as far as St. Blaise, Neuchâtel and Couvet (DB 05.03.1868, FAN 18.03.1868, LC 29.03.1868). Three sizes and their prices were advertised 1869 for the normal red full bricks: (1) Bricks for walls and pillars ($245 \times 116 \times 62$ mm) at 47–52 CHF per 1'000 pieces; (2) Bricks for vaults and strong partition walls ($286 \times 138 \times 60$ mm) at 62–67 CHF/1'000, and (3) Bricks for wedge-shaped vaults ($239 \times 148 \times 59$ mm) at 85–90 CHF/1'000 (SBZ 1869, vol. 14, 4, 171).

The shareholders were called to an extraordinary general meeting on April 15, 1875, to vote on the purchase of a large neighbouring land area enabling the construction of a second factory for the production of roof and interlocking tiles (NZZ 23.03.1875, ZO 20.01.1875). This was the «Tiergarten» area north of the «Binz» area, where the new factory buildings and the clay pits are clearly visible on the 1881 map (Fig. 5.6, circle 3b). From 1877 onwards, several types of interlocking tiles were produced here [ET77, 144].

A second extraordinary general meeting took place on June 28, 1875, to approve the new statutes (NZZ 04.06.1875, DB 16.06.1875). The interlocking tiles received eight years later the best certificate and the diploma for their bricks at the National Exhibition 1883 in Zürich in the jury's test [KO84, 68-73] regarding watertightness and breaking strength (SBZ 05.01.1884). This was proudly noted on the underside oft he interlocking tiles (Fig. 5.9). The company even gave, as «Heurieth», a 10-year guarantee against frost (FE 26.09.1885). In addition to these tiles, ridge and roof tiles, bricks, white and red facing bricks, profile bricks, chimney bricks, drain pipes and ventilation pipes were exhibited (Fig. 5.7). Production was estimated at 14 million pieces annually, fired in three ring kilns [HAR83, 110]. The «Mechanische Backsteinfabrik Zürich» was clearly the dominant factory in Wiedikon/Zürich.

The dividends of the first decades were not reported in the daily press. After 1880, due to the decline in construction activity, there was only a return of 3 to 4.5% (Tab. 11.2). However, they quickly jumped to 7% (1885), and even reached 10% to a maximum of 18% from 1891 to 1898, later settling in the single-digit range. Thus, shareholders could be very pleased with the good business performance.

At the Zürich Cantonal Trade Fair 1894, an annual production of up to 15 million pieces of various bricks and tiles was noted (ISHZ 14.07.1894) and the company received the 1st class diploma. In 1899, the company advertised itself as the most efficient brick- and tile-works in Switzerland with an annual production of 22 million pieces (SBZ 19.08.1899). At the extraordinary general meeting on 1 June 1912, the merger agreement with the «Albishof-Heurieth» brickworks was approved (NZZ 14.09.1912). The new corporation was called «Zürcher Ziegeleien», headquartered in Zürich. The assets and liabilities of both companies were combined, resulting in a share capital of CHF 2.2 million, consisting of 4'400 bearer shares of CHF 500 each.

Figure 5.9: *Upperside (a), underside (b) and two enlarged areas (c, d) of the intact tile ZZ 448 (Dimensions* 420 × 225 × 30 mm*), showing three impressed inscriptions. In the centre «MECH. BACKSTEIN- FABRIK / ZÜRICH/1885» (Height of the letters:* 20 mm*, of the numbers 1 and 8:* 17 mm*, of the number 5:* 18 mm*), below left (c) «DIPLOM/1883» and right (d) «LANDES/AUSSTEL-LUNG/ZURICH» (Height of the letters:* 7 mm*). A raised mark in the form of an inverse italic Roman number two below the large central inscription («‖», height* 12 mm*) can be seen. Photos* MARINO MAGGETTI.

The «Binz» production site was closed after the merger in 1912, while the «Tiergarten» factory continued to operate until 1974 [ET77, 142,144-145]. Today, the «Zürcher Ziegeleien» produces at two locations: bricks and tiles in Istighofen and tiles in Laufen.

The «Genossenschaft zürcherischer Ziegeleibesitzer»

In 1903, the four factories in the city of Zürich merged to form the «Genossenschaft zürcherischer Ziegeleibesitzer» [Zürich Brickworks Owners' Cooperative], whose sales office began operations on January 1, 1904 (NZZ 04.02.1904). The aim was to stop competition and harmful price wars and to agree on mutually acceptable minimum prices.

The «Tonwarenfabrik Bodmer» (1872–1953) in Wiedikon

The history oft the «Tonwarenfabrik Bodmer» [Pottery factory Bodmer] is well known [FR52, BO68, ET77, 128-131]. Rudolf Bodmer (1771–1841) began manufacturing ordinary pottery and green and blue tiled stoves in Horgen in 1803 (Fig. 5.5). In 1819, he moved his manufacture closer to Zürich, i. e. to Riesbach, and continued producing tiled stoves and pottery with six workers as the «Rudolf Bodmer zum Weyer» company. The clay came partly from the rich deposits south of Wiedikon. In 1831/35, the manufacture of clay pipes was introduced and crockery production was discontinued. The workforce consisted of twelve. After the founder's death in 1841, the pottery was continued by his two eldest sons Johann Walter (1805–1866) and Arnold (1807–1849), in association with Johann Biber. When Arnold Bodmer died in 1849, the company was renamed «Thonwarenfabrik Bodmer & Biber». In 1876/77 production reached a peak. The sales area for tiled stoves extended to Central Germany, Vienna, Trieste, Naples, Lyon and Chicago. The workforce grew to 60. One of the employees was Rudolf Puschmann (1846–1914), who painted stove tiles, vases and plates from 1874 to 1890 and also worked as a drawing teacher at the Riesbach craft school from 1876 to 1889 [RI02]. At the National Exhibition in Zürich in 1883, tiled stoves of all types were exhibited (Fig. 5.10).


1375.* Bodmer & Biber, Zürich-Riesbach, Kachelöfen-, Thonwaaren- und Thonröhren-Fabrik.
Kachelöfen aller Bauarten, modernen und antiken Styles, farbig, en relief, bemalt und weiss. — Diverse Thonwaaren.
Bemerkenswerth: Ofen mit Sitzen und Rückwand nach Pfau, Ofen nach Graf, Ofen grün, Relief nach dem im Schloss Wülflingen, moderner Kaminofen mit Spiegelaufsatz etc. — Thonwaaren, speziell für innere und äussere architectonische Decoration, vide die Eingangshalle des keramischen Pavillons. — Badezimmer im Hotelbau. — Pavillon Buchmann Gruppe 15, Brunnen-Nische Gruppe 19 *d*, 11 Nr. 711, 41 *g*.

Figure 5.10: *Excerpt from the catalogue of the fourth Swiss National Exhibition in Zürich 1883 [HAR83, 107].*

Due to differences between the partners of the Riesbach factory, Carl Bodmer-Hegetschweiler (1839–1894) resigned as a partner and founded 1872 in Wiedikon (Fig. 5.6, circle 4) his own factory «CARL BODMER» (SHAB 09.02.1883, 113). The company produced stove tiles, roof tiles, bricks and clay pipes. After Carl Bodmer's death, his widow Anna Bodmer continued with her sons Carl, Gustav and Ernst the business under the name «CARL BODMER & CIE.» (SHAB 23.02.1895, 190). The stove tile production ceased 1900 and the factory closed 1953.

Production aspects and population growth

The fact that four production plants with enormous capactites were operating in Wiedikon is clearly linked to the population growth, not only in the city of Zürich, but also in the neighbouring municipalities. For example, the population of Wiedikon was 1'409 in 1850 [IL15], and recorded an extraodinary increase from 4'681 to 18'355 between 1888 and 1900 (Fig. 5.11). It was during this period that the highest dividends were paid to the shareholders (Tab. 11.2). Twenty years later (1920), the population had almost doubled (31'040).

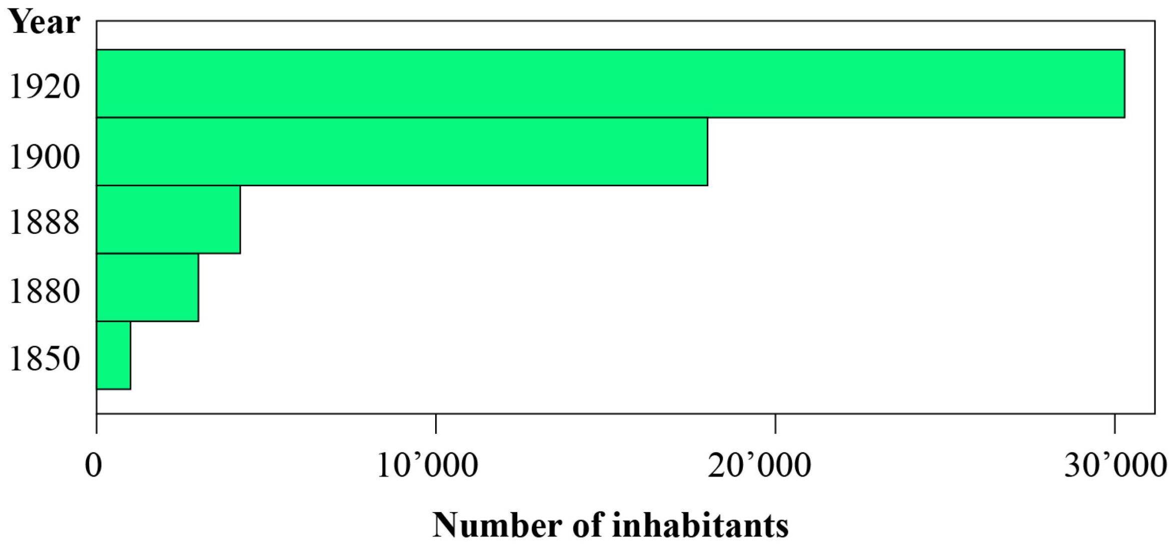


Figure 5.11: *Demographic development of the municipality of Wiedikon [IL15]. Drawing Marino Maggetti.*

The evolution of the factories over time in the Wiedikon region is well documented in the various editions of the Swiss maps on a 1:25'000 scale (Fig. 5.12). At the turn of the century (Fig. 5.12, 1900/1902), compared to 1881 (Fig. 5.6), few new houses can be seen in the village of Wiedikon. The new Reformed Church of Wiedikon, built in 1896, was surprisingly omitted by the cartographer in the revision of the atlas sheet 161 «Zürich» (Fourth edition 1900). Of the four factories, only the «Heurieth» factory and its associated open pit have significantly expanded since 1886. Raw material extraction in both «Tiergarten» and «Binz» open pits was abandoned in 1971 [MUM97, 53]. Today, the factory buildings have disappeared, and the industrial areas have been built over with residential blocks (Fig. 5.12, 2025). Morphologically, only the impressive former mining edge of the «Binz» open pit remains.

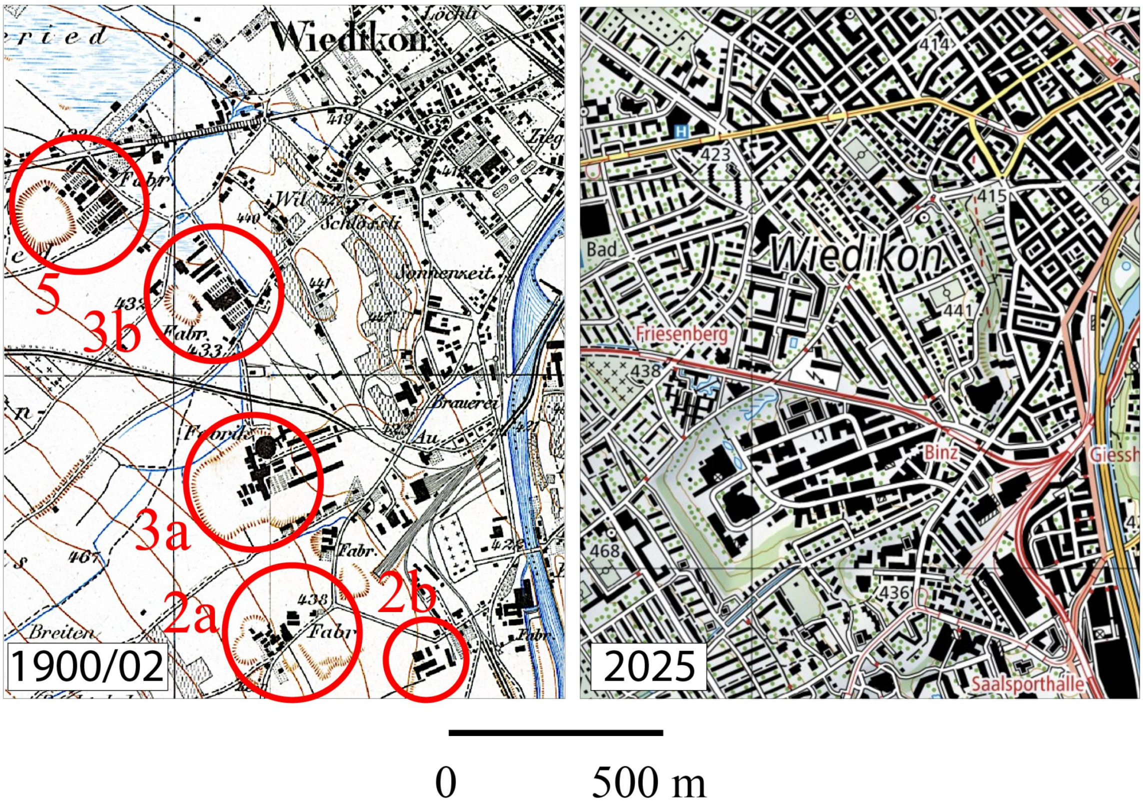


Figure 5.12: *Factory buildings and open pits on the combined 1900 (sheet 161 Zürich) and 1902 (sheet 160 Birmensdorf) editions of the so-called* Siegried *atlas maps 1:25'000, and the 2025 edition of the National map of Switzerland 1:25'000. The Bodmer factory (see fig. 5.6, circle 4) has not been labelled because it is not a brick- or tile factory. © swisstopo. Graphic editing* Marino Maggetti.

Geology

The «Uetliberg loams»

The local geology is well known thanks to the open pits, the many drillings around them [LU07a, LU07b] and recent geological mapping [PA92]. According to the former author, the factories exploited a colluvial clay deposit which he considered to be a product of weathering and eroding the molasse layers (clayey sandstones, marls, and isolated conglomerate beds) of the Uetliberg (Fig. 5.6). It is a recent deposit since it rests on moraine from the last Ice Age. The fatty layers are concentrated mainly at the base of the alluvial cone, which explains why the mechanical factories were located there. In figure 5.6, between the village of Wiedikon and the factories, a moraine hill around «Wil

Schlössli» and covered with many vineyards (vertical line signatures) can still be seen, on which many villas and the new Reformed church of Wiedikon were built in later years. The «Mechanische Backsteinfabrik Zürich» supplied the facing bricks for the facade of this church, erected in 1896 (SBZ 05.12.1896).

A modern description and interpretation of these Late Pleistocenic to Holocenic clayey-sandy deposits («Uetliberglehm» [loam of the Uetliberg]) is provided by Pavoni et Al. [PA15, 109-112,147]. They overlie the last moraines of the Linth-Rhinevalley glacier and reach in the higher slope areas maximum thicknesses of 30 m. In the middle, they are still about 20 m thick. In 2006, numerous pine (*pinus silvestris*) trunks were excavated from the Uetliberg loam, which were still rooted in the underlying molasse. The ^{14}C-dating revealed an age of 12.4 – 12.6 cal. BP. Other pine trunks rooted in clay and excavated in 2013 yielded similar ^{14}C-dates of 12.8 – 13.8 ka BP. The authors calculated a clay accumulation rate of about 1 – 1.5 mm per year.

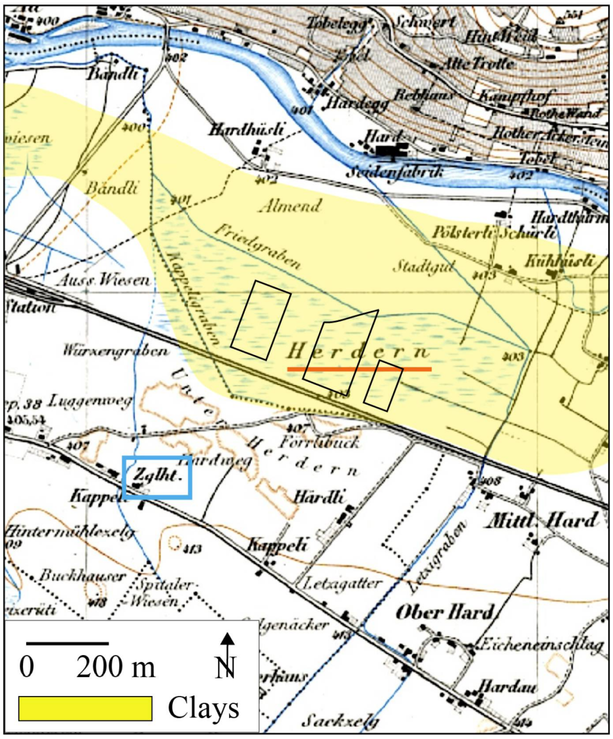


Figure 5.13: *The «Herdern» (red underlined) marshland south of the River Limmat and east of the village Altstetten with the extension of the clay deposits according to* Lugeon *[LU07c, fig. p. 366]. The major extraction sites in 1907 are shown as rectangles. In the blue rectangle: a traditional hand-made brickworks («Zglht.»). Sheet 158 Schlieren of the so-called* Siegried *atlas maps 1:25'000, 1877. © swisstopo. Graphic editing* Marino Maggetti.

Borholes and profiles

Lugeon took detailed profiles of the pit walls and collected samples for chemical and technical analyses.

«Heurieth» open pit: Lugeon published five detailed profiles of the clay extracting edge. In profile 3, eight layers were distinguished under the 3.1 m thick overburden: (1) Clay, yellow, meager, with red patches (0.85 m); (2) Sand (0.2 m); (3) Clay, yellow, meager (0.3 m); (4) Sand (0.2 m); (5) Clay, yellow, meager (0.7 m); (6) Clay, blue, partly meager, partly fatty (2.1 m; *Sample no. 13*); (7) Gravel & sand (1.0 m), (8) Clay, blue, with many thin sandlayers (3.7 m; *Sample no. 14*). *Sample no. 11* was mixed from layers 1 and 2 and *sample no. 12* from layers 3 and 5.

«Binzhof» clay area and open pit: LUGEON presented 23 borehole profiles and four detailed profiles of the clay extracting edge. *Sample no. 1* is a yellow, meager clay from a 0.75 m thick layer, *sample no. 2* a mix from a yellow, very fatty clay layer (1.2 m) with a sand layer (0.3 m), *sample no. 3* a mix of a blue, meager clay layer (0.55 m) with a sand (0.1 m) and a blue, meager clay layer (1.6 m), *sample no. 4* a mix of three grey and blue clay layers with two sand layers and *sample no. 5* a blue, fat clay (3.0 m). The color of the fired bricks is yellowish to whitish.

«Tiergarten» clay area and open pit: According to LUGEON, the deposit is generally clay-richer than at «Binzhof». However, the layer thickness is thinner. The following samples were taken from the exploitation edges: *sample no. 6*, clay, yellow, fat (1.0 m thick layer); *sample no. 7*, clay, yellow, sometimes meager (0.6 m); *sample no. 8*, a mix of two layers of meager blue clay with a layer of sand; *sample no. 9*, a mix of one layer sand (0.15 m) and one layer blue clay (2.25 m); *sample no. 10* a clay, blue, fat, with small sand layers (2.0 m). The firing color was light red for the top 40 cm, yellowish for the underlaying 70 cm and whitish for the main mass. Due to the high purity of the clays, sand addition from Benken, Uetikon and Lausen (BL) was necessary for the body paste.

The clays/loams from «Herdern» (Altstetten)

In the marshy plain east of the village of Altstetten, near «Herdern», clay deposits with a variable total thickness of 1 to 2.5 m lie on gravel [LU07c], see figure 5.13. LUGEON distinguished three clay layers in the profile (from top to bottom): (1) brown clay (0.2 to 0.5 m thick; (2) black clay (0.2 to 0.3 m) and (3) green or blue clay (0.5 to 2.0 m). He sampled a mix of layer 1 and 2 (= *sample no. 15*), while *sample no. 16* was taken from layer 3.

At the beginning of the 20th century, according to this author, these raw materials were mainly exploited by the «Mechanische Backsteinfabrik Zürich» and the «Dampfziegelei Heurieth», which mixed them with their other materials («Uetliberg loams») to obtain a reddish firing color. Indeed, the color of the «Tiergarten» clay samples fired at 1050 °C was «light red» up to a depth of 40 cm, «yellowish» between 40 and 110 cm, and «whitish» below [LU07b, 425], which fits well with the increasing MgO and CaO contents the deeper the sampling was carried out (Tab. 5.3). A low-lime additive was therefore necessary to obtain the desired brick-red color. This was found in the «Herdern» area, as evidenced by the red firing color for clays from layer 1 respectively the light red firing color for those from layers 2 and 3.

Chemical composition of the clays/loams and their mixtures

LUGEON doesn't specify what the mixtures from the «Uetliberg loam» open pits were intended for. Were they proven blends used by the factories for their brick and tile production, especially since the pits had been mined for several

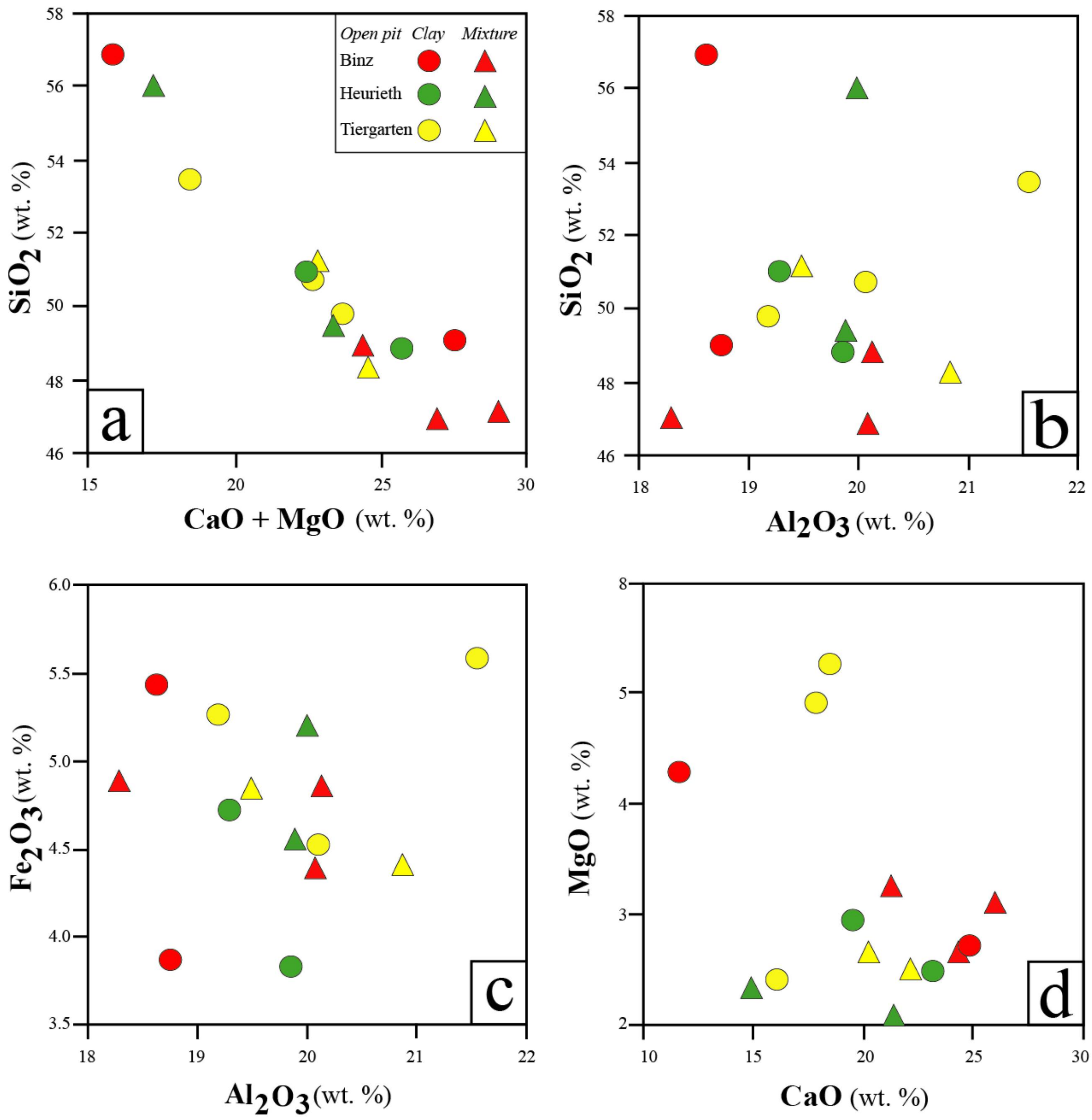


Figure 5.14: *Four binary plots of the clays and the mixtures from the open pits and the factories as collected by* Lugeon *[LU07a, LU07b] and published by* Zschokke *[ZSC07], see table 5.3. Drawing* Marino Maggetti.

decades? Or simply test mixtures? The chemical analyses carried out by H. Stahel [ZSC07, 132] show no significant differences in the chemical composition of the «Uetliberg» pit samples examined (Tab. 5.3). This is also shown in the four binary diagrams (Fig. 5.14), in which neither a grouping of the analyses per extraction pit nor one per type (clay, mixture) is documented. Only one single and clearly negative correlation is revealed in the SiO_2-CaO+MgO plot (Fig. 5.14a). It is not surprising that there are no major differences between the analyses from the three pits, as they were located next to each other in the same lithology. On the other hand, one would expect that the sandy mixtures would contain much more SiO_2 than the pure clays, but this is not the case (Fig. 5.14a). Furthermore, the clays should be richer in Al_2O_3 than the sandy mixtures, but this is also not the case according to figures 5.14b and 5.14c. Finally, the statement that in the «Tiergarten» pit «[...] der Ton ist im allgemeinen fetter als im Binzhof» [the clay is generally fatter than in Binzhof] [LU07b, 422] may be correct according to figures 5.14b and 5.14c and would explain why this factory preferentially produced roof tiles, but caution is advised in view of the small number of analyses. In contrast to the «Uetliberg» samples, those from the «Herdern» deposits are significantly richer in silica and poorer in CaO and MgO (Tab. 5.3).

Samples, analytical methods and aims of the research

Samples

During his hikes, the first author often came across broken roof tiles that were mainly used to pave waterlogged country lanes. He couldn't help but pick up marked pieces, i.e. those showing a company name and, if possible, also dates. Of the factories operating in Wiedikon/Zürich, only roof tiles from the «Mech. Backsteinfabrik Zürich» were found (Tab. 5.4). Two intact tiles (ZZ 68) come from a remote village in Ticino, two more (ZZ 448, ZZ 449) were given 2022 to the first author by Jean-Baptiste Vuille (Zuchwil), which he had collected from a house demolition. The other samples were found in rubble heaps in the cantons of Bern and Fribourg. A total of 24 mostly broken tiles were collected, which, it should be emphasized, do not correspond to a targeted prospection, but to a random collection (Tab. 5.4). The locations show impressively how far the roof tiles of the «Mechanische Backsteinfabrik Zürich» were traded, in contrast to the neighbouring, strongly competing factories in Wiedikon/Zürich.

Figure 5.15: *Detailed view of the central parts of the underside of tile ZZ 280. Image width:* 120 mm. *Photo Marino Maggetti.*

The factory name can only be observed on the protected underside of the tile (Fig. 5.9). Since the collected objects to be examined are mostly broken, incompletely preserved inscriptions respectively marks can be seen. Three different types of factory designations were found (Tab. 5.4), which at the same time also correspond to different tile shapes.

The first type has already been presented in figure 5.9. Typologically, it belongs to the «Geradelaufender Einfachfalzziegel» [Straight single interlocking tile] [HA40, 27] with three separate and deeply pressed inscriptions in capital letters and numbers: in the centre «MECH. BACKSTEINFABRIK / ZÜRICH / [production year]», on the lower left «DIPLOM / 1883» and on the lower right «LANDES / AUSSTELLUNG / ZURICH». This type includes the samples ZZ 448 and 449 (both production year 1885), ZZ 68 and ZZ 280 (both 1887), see table 5.4. A more detailed inspection reveals that the last number of the production year, with its height of 22 mm, differs significantly from the first three numbers, which are 15 mm high (Fig. 5.15). One can also still see the imprint of the rectangular plate on which the number was embossed. Apparently, for cost-saving reasons, only this last digit was replaced on the models each year. In addition to these inscriptions, raised slashes can also be seen at the bottom edge (two for ZZ 448 and ZZ 449, four for ZZ 280) and individual letters («H» for ZZ 68, «M» for ZZ 280: Fig. 5.15) to the left of the large inscription, which have clearly been carved into the model by hand. The latter are missing in ZZ 448 and ZZ 449, the two oldest tiles (1885) of the analyzed series. What these lines and letters mean could not be deciphered yet. As a matter of fact, this type of roof tile was the third to be developed in the 19th century by the Gilardoni brothers in their factory in Altkirch/Alsace [CAT94, tab.10].

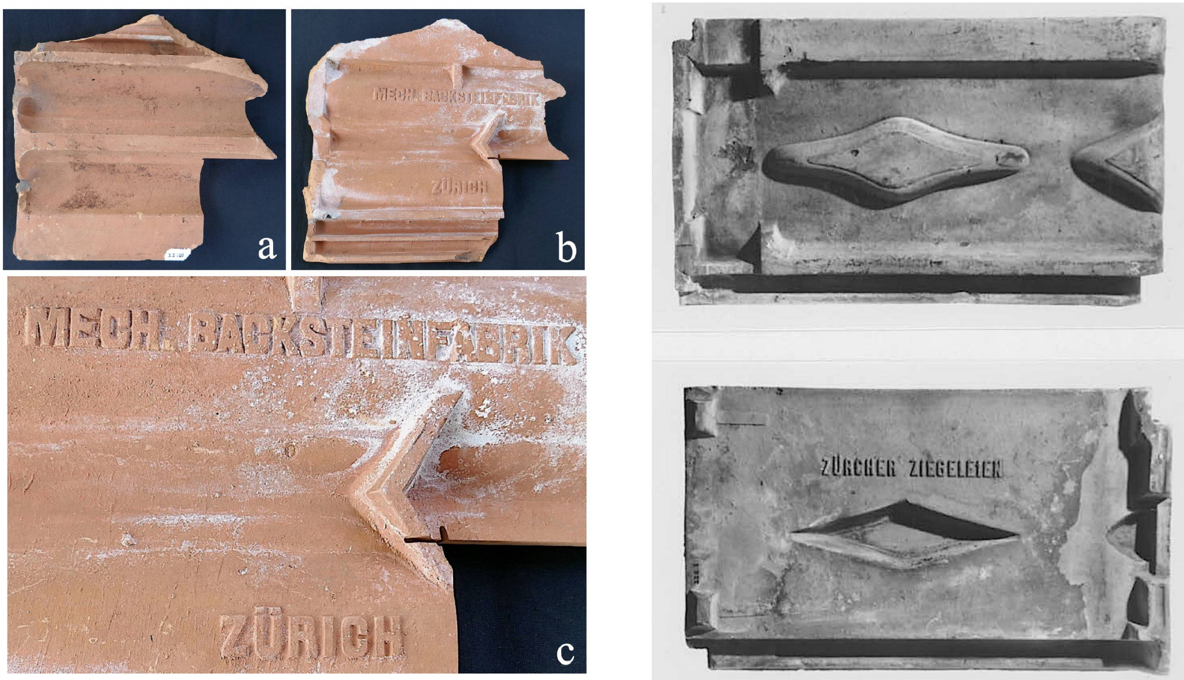
The second roof tile type belongs typologically to the «Herz-Einfachfalzziegel» [heart single interlocking tile] [HA40, 31] and has a marked, 180 mm wide diamond-shaped depression in the central area of the underside, which is visible as a distinctive elevation on the top (Fig. 5.16A, 5.16B). Above and below the heart diamond the same designation in capital letters appears as in type 1, but in different font and size (Height 18 – 19 mm): «MECH. BACKSTEINFABRIK / ZÜRICH / [production year]». The last number of the production year does not differ from the three preceding ones, which are 21 mm (ZZ 28, 1907) or 17 mm (ZZ 282, 1915) high. The inscriptions on the right and left side are the same as in the first type (letter height: 14 mm). Three tiles of this type were found: ZZ 281 (production year 1907), ZZ 282 (1915) and ZZ 329 (1906). This roof tile type was developed in Alsace by the Gilardoni brothers as their model No. 1 interlocking tile, which they patented in 1841 [CAT94, tab.1]. This world's first real interlocking and pressed roof tile had immense success in and outside of Alsace. It was mainly used in mountainous areas because its surface design meant it could hold snow better than other tiles [HA51, 71]. As far as the Swiss roof tiles analyzed so far are concerned, these Zürich examples are the first heart tiles in our nationwide

(A) (B)

Figure 5.16: **(A)** *Upper- (a) and underside (b) of the broken (and sawn there) heart tile ZZ 281. The dashed rectangles on the left and right correspond to those in figure 5.9 (c, d). A narrow strip of the left side of the roof tile was sawn away. Current dimensions:* 240 × 220 mm. *Photos* MARINO MAGGETTI. **(B)** *Upper- (a) and underside (b) of the broken tile ZZ 282, dated 1915. A narrow strip of the left side of the roof tile was sawn away. Current dimensions:* 295 × 1225 mm. *Photos* MARINO MAGGETTI.

analysis series. The analyzed heart tiles differ in some details and therefore represent different subtypes, which were apparently produced simultaneously. For example, the roof tile ZZ 281, dated 1907, has an elongated recessed groove above the company name (Fig. 5.16A), which is missing in the tiles ZZ 329 from 1906 and ZZ 282 from 1915 (Fig. 5.16B).

The third tile type, a «Mulden Doppelfalzziegel» [Hollow double interlocking tile] [HA40, 29], is again different, but unfortunately no complete specimen could be found (Fig. 5.17A). On the underside, the same inscription, in capital letters «MECH. BACKSTEINFABRIK / ZÜRICH» can be read as on the first two types. However, the production years and both references to the 1883 National Exhibition are missing. The font is again different (Height 11 mm, the «Ü» 14 mm), and the letters are no longer pressed in, but are raised on the underside. With 15 specimens, this type accounts for the largest part of the analyzed tiles. This roof tile type was originally developed as their model no. 2 by the Gilardoni brothers [CAT94, tab.3] and further developed by other factories. It features a large central rib between two troughs, allowing for faster drainage of rainwater by increasing its flow velocity.



(A) (B)

Figure 5.17: **(A)** *Upper- (a), underside (b) and enlarged view of the inscription area of the broken tile ZZ 191 (current dimensions:* 256 × 110 mm*). Photos* Marino Maggetti. **(B)** *Upper- and underside of a roof tile with the raised mark «ZÜRCHER ZIEGELEIEN». Dimensions:* 390 × 230 mm. *Ziegelei-Museum Meienberg, Cham (Inv. No. 225.1) © and photos* Ziegelei-Museum Meienberg, *Cham.*

Two small roof tile fragments (ZZ 333, ZZ 334) cannot be assigned to one of these tile types due to their small size and the fragmentary nature of the company name. However, they could belong to type 1 or 2 (or another type of the early production period), but certainly not to type 3, especially since their cross-section shows the same inhomogeneous structure, i.e. some beige, rounded to streaky inclusions in a red matrix (see below) as roof tile types 1 and 2.

The analyzed tiles belong to the company «Mechanische Backsteinfabrik Zürich». As already discussed, these roof tiles were not manufactured in the «Binz», but in the «Tiergarten» factory of this company, which produced exclusively tiles from 1877 onwards. The three types of roof tiles were still in production at the «Tiergarten» factory in 1940 and 1951 [HA40, HA51]. ZZ 68, 280 448, and 449 (all stamp type 1) with their dates 1885 and 1887 are among the first products of the «Tiergarten» tileworks. The second type specimens (ZZ 281, 282, 329) show production years between 1906 and 1915. The latter year is surprising, since it would have been expected that after the fusion of 1912 the old models with the company name «Mechanische Backsteinfabrik Zürich» would have been replaced by new ones with the «Zürcher Ziegeleien» brand. Such tiles with the company stamp «Zürcher Ziegeleien» do exist, but they no longer bear the production year (Fig. 5.17B). It is therefore not clear when these tiles were manufactured. But that as it may, it seems obvious that the old models were probably continued to be used for cost reasons as long as possible. Seemingly, this took several years until they were finally worn down. No production year is noted on the third tile or stamp type. As shown by the font typology and the lack of references to the diploma and the 1883 National Exhibition, it can be concluded that this tile type must be younger than the other two. Based on the company mark, it can further be concluded that the models were manufactured before 1912 and remained in use for some time beyond that year. The National Exhibition 1883 had already taken place almost 20 years ago and a reference to it might not have been appropriate any more. For this reason, it can be hypothesized that this type of tile went into production around 1900. In summary, it can be stated that the roof tiles examined were made between 1885 and approximately 1915.

Analytical methods

Milling

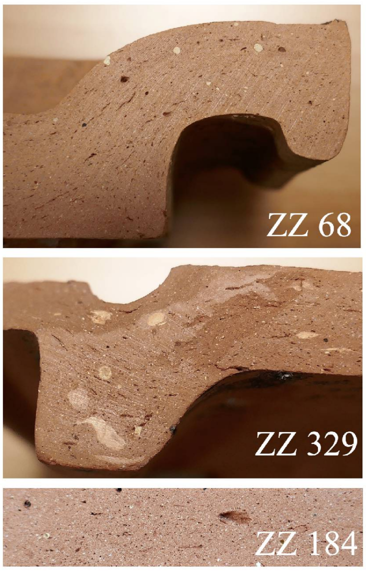
For the chemical analyses, the possibly contaminated outer millimeters of the samples were ground off. The cleaned and dried samples were then finely ground in a tungsten carbide mill. The powders obtained in this way weighted 10 to 25 grams.

Microscopical analysis

A thin section was prepared from mostly all samples. The first author examined them under a polarization microscope. Since these samples proved to be homogeneous, no thin sections were produced from ZZ 397–398, 400, 402, 406, 407, 410, 411, 414–417, 419, 421–424, 426–428, 448–449. For the terminology, see Maggetti [MAG89, MAG09].

Chemical analysis by X-ray fluorescence (XRF)

22 analyses were carried out in the geochemical laboratory of the Department of Geosciences at the University of Fribourg (Switzerland) by the second author. 2 grams of powder per sample were calcined in an electric furnace under oxidizing conditions at 900 °C to determine the loss on ignition (LOI). Then 0.700 g of the calcined powder was mixed with 6.650 g of MERCK Spec-



(A)

Mechanische Backsteinfabrik Zürich.
Dieses Etablissement liefert genau geformte
Falzziegel
aus dem besten weissen und rothen Thon gemischt hergestellt, zu billigem Preise, mit Garantie.
Ebenso werden weisse, mit der Maschine gepresste
gewöhnliche Dachziegel
sowie Backsteine, weisse und rothe Verblendsteine, Hohlsteine für Galandage, Kaminsteine etc. bestens empfohlen.
3646] *Bureau:* Schweizergasse Nr. 6, Lintheschlerplatz *Zürich.*

(B)

Figure 5.18: **(A)** *Macroscopic aspects of textures I (ZZ 68, ZZ 329) and II (ZZ 184). Sawn sample area, image widths* 5 cm. *Ca-rich elements appear as light yellowish dots, grains and areas in the otherwise red tile. Photos* MARINO MAGGETTI. **(B)** *Advertisement with reference to the «[...] Mischung von weissen und rothen Thon» [mixture of white and red clay] for the production of interlocking tiles (EC 14.8.1880, 46).*

tromelt A10 ($Li_2B_4O_7$) and 0.350 g of MERCK lithium fluoride (LiF), and melted in a platinum crucible for 10 minutes at 1050 °C in a PHILIPS PERL X-2 device to form a glass pill. The main, secondary and trace elements were measured on these pills using a wavelength-dispersive X-ray fluorescence device PHILIPS PW 1400 (Rhodium cathode, 60 kV and 30 mA). The calibration was carried out with 40 internationally certified standard samples. Accuracy (accuracy) and scatter (precision) were checked with internal laboratory reference samples. The errors are below 5% for all elements.

Statistical treatment

The treatment of the chemical analyses was carried out by the first author with the help of the program SPSS (Statistical Package for Social Sciences), especially for the construction of the binary diagrams.

Aim of the investigation

The research tried to clarify the following questions: (1) Are the four roof tile types materially, i. e. chemically and mineralogically - petrographically similar or different? (2) Do they chemically match the clays? (3) Are there differences to the tiles examined so far [MAG20, MAG22, MAG23] ?

Since the present work deals with the chemical composition of roof tiles, the colour of the fired products is not considered. There is a wealth of literature on this subject (e.g. [KRE85, NOL88, MEY03]). A phase analysis by means of the powder X-ray diffractometry was not carried out, since the optical microscopic examination revealed an optically isotropic matrix in practically all samples, from which it can be concluded that the firing temperatures and conditions were very similar in all factories (Assumed firing temperatures: around 1000 °C; oxidizing furnace atmosphere). There are countless articles on the mineralogical reactions during the firing of ceramic pastes, see the summary by [HEI14, 70-102]. With regard to the Swiss brick and tile bodies, reference is also made to other detailed papers [IBE71, IBE72, PET73, PET78, MEY84, FÜR93, FÜR98, MUM95, CUA00], which contain some chemical analyses. A seminal paper provides a comprehensive overview of the raw materials used in the Swiss brick and tile industry [MUM97].

Results and Discussion

As a reminder to what has been said before: white-firing as well as red-firing clay layers were frequently encountered in the boreholes and profiles of the open pits [LU07a, LU07b]. Apparently, due to the very lime-rich composition of the Uetliberg raw materials, the red clay required for the production of the interlocking tiles had to be brought from more distant clay pits in the «Herdern/Sihlfeld» area, about 1.5 km NW of the «Tiergarten» roof tile factory [ET77, 144] [GU62, 9] [LU12, 27], see figure 5.13. As already mentioned, sand was also added to the roof tile paste mixtures of this factory.

Visual aspects: poor mixing for texture I tiles

The textural aspect of the roof tiles type 1, 2, 3 and unkown is microscopically heterogeneous. Most striking are the light-beige rounded to streaky inclusions or pellets in the otherwise reddish body visible on the sawn specimens (Texture I, Fig. 5.18A). Such a light-beige colour indicates a calcium (Ca)-rich composition. Similar inhomogeneous textures were also observed in the Allschwil and Laufen roof tiles [MAG23]. Clustered cracks parallel to the roof outlines are common. The macroscopic and microscopic picture is to be interpreted that a Ca-poor material was mixed with a Ca-rich one as documented in an early advertisement from 1880 (Fig. 5.18B). Evidently, the mixing process for tiles of texture I must have been poor because no thorough homogenization was achieved. In contrast, the mixture in the case of the tiles of texture II (all type 3 tiles) was significantly better, as only a few very thin inhomogeneities can be seen in the cross-section (Fig. 5.18A).

Microscopic aspects: well fired bodies

Under the polarizing microscope, the ceramic bodies show a silty (meager) and very fine-grained structure. The matrix, i. e. the former clayey groundmass of all tiles appears optically isotropic under the microscope with

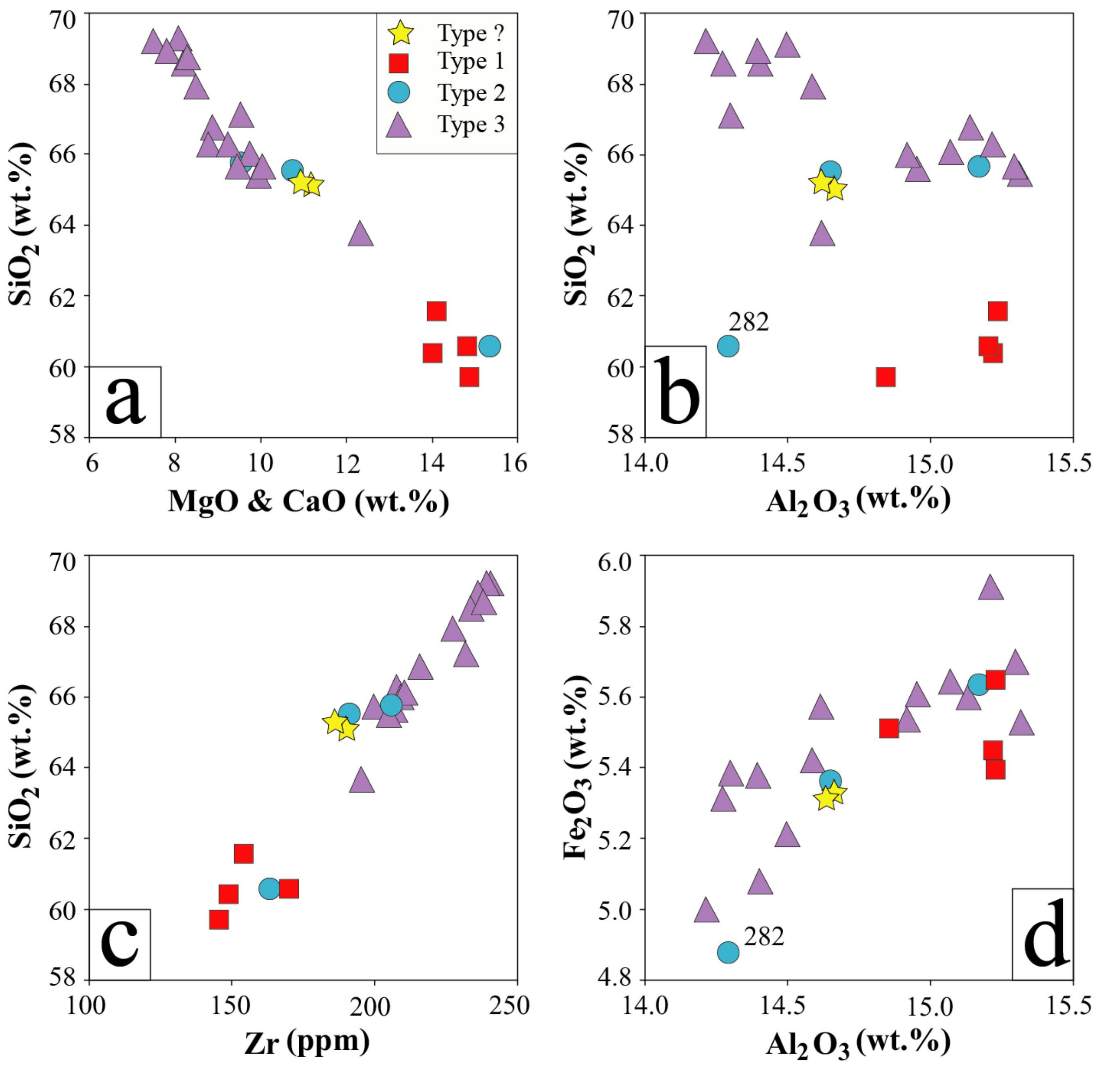


Figure 5.19: *Location of the 24 roof tiles analyses in four binary correlation diagrams. Drawings* MARINO MAGGETTI.

crossed polarizers, indicating a good firing process around 1000 – 1050 °C. The maximum grain size of the non-plastic inclusions is in most cases below 0.10 – 0.14 mm and rarely reaches 0.28 mm. Grains of up to 0.71 mm occur in some tiles. The non-plastic inclusions are predominantly rounded-edge quartz, with some kalifeldspar, plagioclase and granitic fragments. These appear macroscopically as white dots. Fe-rich argillaceous inclusions can reach diameters up to 2.28 mm. Further, few round inclusions full of secondary crystals, probably calcites, which were formed retrogradely after firing from the CaO of the decomposed primary carbonates, can also be observed. Small flakes of white and dark micas (Appearing as red, oxidized grains) are present in minor amounts. The large, already macroscopically clearly visible light yellowish pellets and streaky layers are extremely fine-grained and show a sharp border to the surrounding red matrix. In addition to a few tiny quartzes, Fe-flakes and secondary carbonate crystals, probably calcite, can be observed in them. In contrast to all others, ZZ 280 is significantly fatter with few larger grains. Finally, the hiatal structure of ZZ 282 could be explained by the addition of a sand fraction.

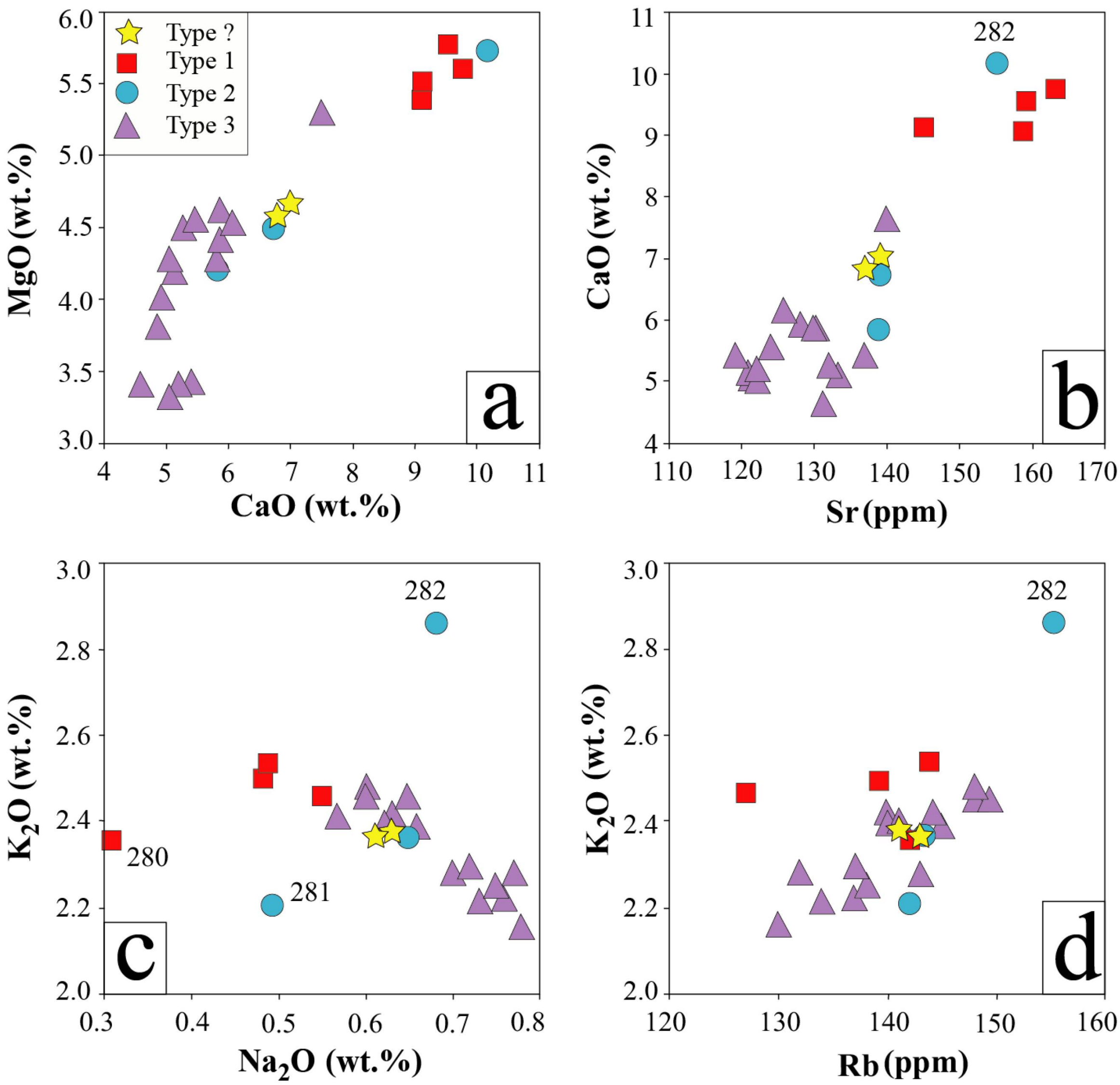


Figure 5.20: *Location of the 24 roof tiles analyses in four binary correlation diagrams. Drawings* Marino Maggetti.

Chemical arguments for clay mixtures and sand additions

Based on 24 chemical analyses (Tab. 5.5) it was checked whether the roof tile types differed.

In the SiO_2 – MgO & CaO binary diagram, the analyses lie along an imaginary negative correlation line (Fig. 5.19a). However, type 1 roof tiles have significantly less silica, but more MgO and CaO than type 3 tiles. Of type 2, ZZ 282 joins the four type 1 analyses, while the other two, like those of the unknown type, plot among the type 3 analyses. The arrangement of all analyses along a negative correlation line fits very well with the technological tradition, according to which two raw materials, one richer in SiO_2 and poorer in CaO, with one containing less SiO_2 but more CaO, were mixed. This was already recognized macroscopically as poorly mixed bodies (Fig. 5.18A). A strong positive correlation of silica versus zirconia as well as the separation into two groups can be observed in figure 5.19c. This is not surprising, since the heavy mineral zircon accumulates in the sandy, i.e. quartz [SiO_2]-containing fractions of the clays, and zircon also contains silica in its formula [$ZrSiO_4$]. The contrast between the older tiles of type 1 (1885-1887), with lower Si- and Zr-contents, and the younger bricks of types 2 (except ZZ 280), 3 and unknown, with higher Si- and Zr contents, can best be explained by the addition of sand in the younger bricks.

In the SiO_2 – Al_2O_3 diagram, types 1 and 3 differ again, because the former contain less silica (Fig. 5.19b). A less pronounced positive correlation is observed between both iron and aluminum oxide (Fig. 5.19d). This correlation shows that iron-containing chlorites were also present in the aluminum-rich clay fraction of the raw materials. In this diagram, the analyses overlap. However, the four type 1 analyses group better than the others, which are more scattered. ZZ 282 has the lowest iron content. The positive correlation of MgO and CaO (Fig. 5.20a) is most probably related to the presence of the mineral dolomite [$Ca,Mg(CO_3)_2$] in the raw materials, while the deviations to CaO-richer compositions for the type 1 roof tiles testifies increased calcite [$CaCO_3$] levels. In the CaO – Sr diagram, too, the analyses are grouped close to an imaginary correlation line (Fig. 5.20b). The diagram shows again that the roof tiles type 1 contain significantly more CaO than the other types.

The main supplier of calcium in sediments is the mineral calcite. In its lattice, Ca can be replaced by the trace element strontium [Sr]. The extent of this replacement depends on the geological history of the mineral respectively its origin. In the present case, it can be concluded that the raw materials experienced more or less the same geological history, since only one correlation line appears. The K_2O – Na_2O diagram shows a negative correlation for most roof tiles (Fig. 5.20c). Only ZZ 280 (Type 1) as well as ZZ 281 and ZZ 329 (Type 2) do not follow this correlation. This can best be explained by the presence of

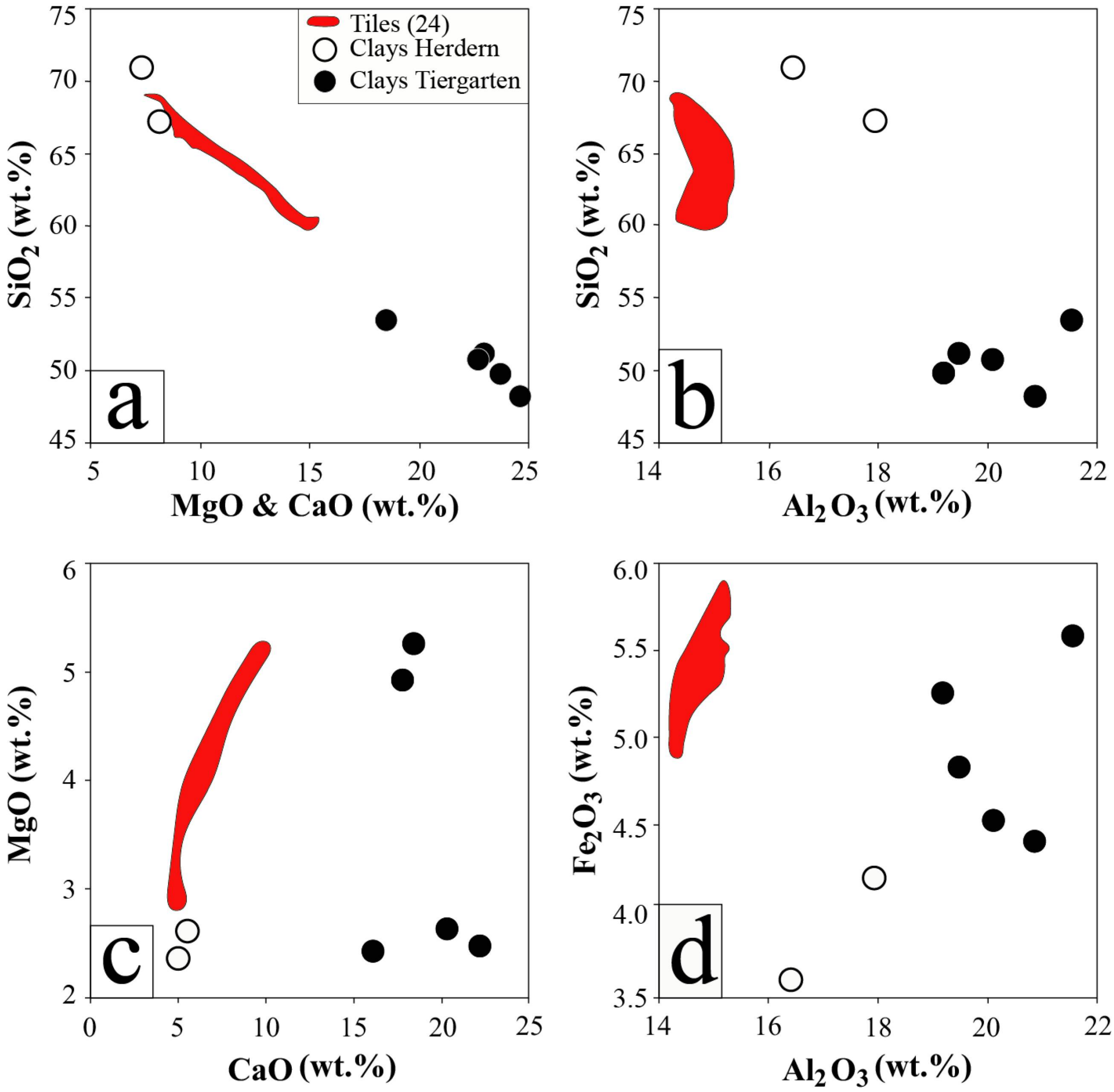


Figure 5.21: *Location of the 24 roof tiles analyses and the seven clay analyses [ZSC07, 132] in four binary correlation diagrams. Drawings* Marino Maggetti.

potassium feldspar [$KAlSi_3O_8$], in whose structure a small amount of sodium can replace the potassium. Rubidium [Rb] is broadly positively correlated with K_2O, which can also be explained by the replacement of potassium by rubidium in the crystal lattice of this kind of feldspar (Fig. 5.20d). In summary, the diagrams clearly show that the older type 1 roof tiles must have been made from a different mixture than the younger type 3 tiles.

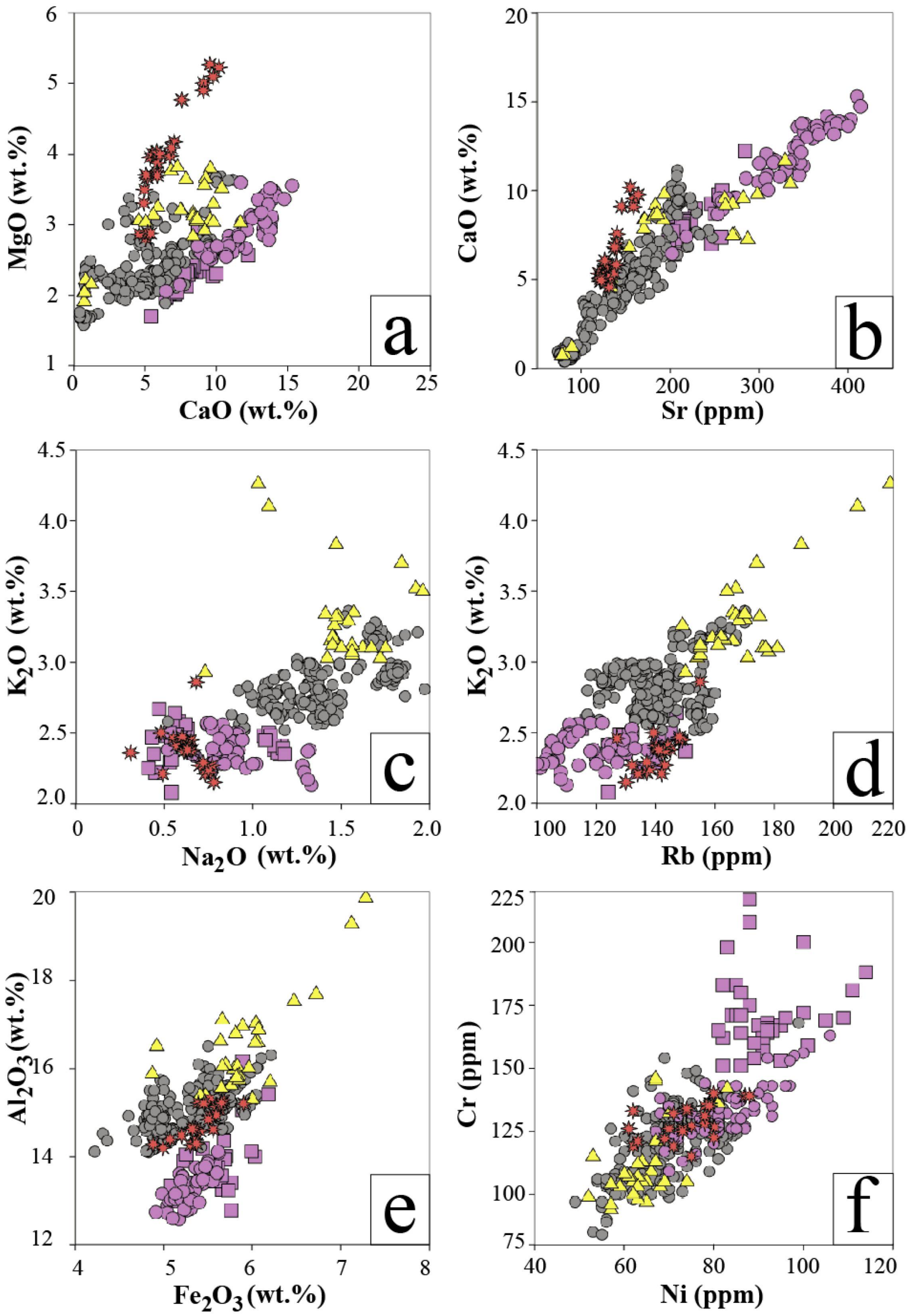


Figure 5.22: *Comparison of 24 roof tiles from Wiedikon/Zürich (this study) with 372 previously analysed Swiss roof tiles. Symbols (raw materials): brownish black = Quaternary, violet = Oligocene (Circles = Allschwil tiles, rectangles = Laufen tiles), yellow = Miocene, red stars = Wiedikon/Zürich tiles. Drawings* Marino Maggetti.

No agreement with the clay analyses of 1907

From the literature [LU07c] and advertisments in newspapers (Fig. 5.18B), as well as based on the macroscopic and chemical aspects, it is evident that the analyzed roof tiles are mixtures of at least two clayey raw materials, one richer in SiO_2 and poorer in MgO & CaO, with one containing less SiO_2, but more MgO & CaO. As already discussed, the «Tiergarten» pit raw materials could be considered for the latter and the «Herdern/Sihlfeld» raw materials for the Ca-poor counterpart. In this context, it should also be remembered the «Tiergarten» mixtures reported by LUGEON do not fit. Were these mixtures merely attempts to avoid transport costs from the open pits in «Herdern/Sihlfeld»? Or mixtures that never reached production?

Since the roof tiles examined most probably all originate from the «Tiergarten» factory, it was interesting to compare their chemical composition with that of the raw materials from the «Tiergarten» and the «Herdern» open pits (Tab. 5.3). As figure 5.21a shows, the 24 tiles lie on a correlation line between the two raw materials. A mixture of these materials therefore seems plausible. However, this is contradicted by the three other binary diagrams (Fig. 5.21b, c, d), where the analyzed tiles should also lie on a correlation line between both raw materials if they were indeed made from a mixture of both. Visibly, this is not the case at all. Such a result may be disappointing, but it should be remembered that the number of raw material analyses is still small. Secondly, we cannot compare 1:1 the results of analytical methodologies used at the beginning of the 20th century with those of today, which are 120 years younger. Furthermore, it should not be forgotten that according to LUGEON, sand from «Benken», «Uetikon», and «Lausen» was also mixed into the tile pastes [LU07b, 425]. It is therefore quite possible that other ingredients have been added to the ceramic paste, the composition of which has not been published for whatever reason.

A specific chemical composition

We have studied so far 15 Swiss tileworks. They exploited raw materials belonging either to clays/loams of Holocene and Upper Pleistocene, Miocene (Aquitanian), or Oligocene (Rupelian) age, see table 5.6. Attention: the Allschwil factories are listed twice in this table, as they mixed raw materials of different geological ages (Rupelian marl & Holocene Loess). Based on this large data set of 372 analyses, the question arose as to the extent to which the 24 Zürich/Wiedikon roof tiles examined differ. The differences between the 15 tileworks analyzed so far have already been discussed [MAG23, 157-159] and need not be repeated here. The new 24 analyses of the «Tiergarten» factory agree chemically only in a few aspects with the Rupelian (Fig. 5.22c, d) or the Holocene/Upper Pliocene raw materials (Fig. 5.22c, f), but not at all with the Miocene clays and loams. The «Tiergarten» tiles in figures 5.22a–e also follows imaginary correlation lines, which differ significantly from the others, if any. This result is not very surprising, since the «Tiergarten» tiles were made from Quaternary deposits of different origin and age, namely a mixture of Quaternary Uetliberg clay/loam (= weathering product of the Miocene subsoil of the Uetliberg) and the Quaternary sediments in «Herdern». The 1:25'000 geological map «Zürich» only shows gravel deposits from the Sihl river as underground of this formerly very swampy area, but no clay deposits [PA92], although the latter are mentioned in the explanatory notes [PA15, 147]. In 1907, these clays were interpreted as a mixture of *in situ* formed superficial weathered layers of the underlying gravel deposits with washed-up weathering products of the surrounding Tertiary molasse and Quaternary moraine [LU07c, 366]. Last but not least, it is worthwile to stress that the six tiles already mentioned in Fig. 5.21 show the highest MgO contents of all 396 tile analyses. Obviously, the geological history of the «Tiergarten» and «Herdern» raw materials resulted in a very specific and differentiable chemical composition that has been preserved in their roof tiles.

Conclusion

The 24 marked «Backsteinfabrik Zürich» tiles complete the results published to date [MAG20, MAG22, MAG23], summing up in a total of 396 chemical analyses. Chemically, the new data can be easily differentiated from the 372 tiles examined so far. Macroscopic and microscopic evidences show that at least two raw materials were used in the «Tiergarten» factory of the «Backsteinfabrik Zürich» company. One was Ca-poor, the other Ca-rich. The mixing process was in the early production years not perfect and mostly resulted in a heterogeneous texture. An addition of sand documented in written sources fits well with the chemical analyses of the younger bricks. Unfortunately, there are not enough chemical analyses of raw materials available to better document or quantify the mixing technique.

Acknowledgements

This work was printed with the genereous financial support of the Ceramica - Stiftung (Basel) for which we are very grateful. We would further like to thank Hannes Flück (Ziegelei-Museum Meienberg, Cham) for the figure 5.17B, Franz Stocker (Zürich) for providing important historical reference books, Raphael Tschanz (Genossenschaft Heimat- und Ortsmuseum Wiedikon) for many informations, Jean-Baptiste Vuille (Zuchwil) for his significant help in the tile prospection, Odette Marbacher (Fribourg) for the exemplary production of the XRF glass pills, Jean Charrière, Paul Bourqui and Patrick Dietsche (Fribourg) for the perfect manufacturing of the thin sections and Alexandre Salzmann (Fribourg) for the chemical analyses of

ZZ 448 and ZZ 449.

Author contributions

The first author collected the samples, made the microscopical analyses as well as the historical research and wrote a first draft of the paper. The second author did the majority of the chemical analyses, reviewed the text and corrected it.

Abbreviations

- **BZ** BERNER ZEITUNG
- **DB** DER BUND
- **CSZ** CHRONIK DER STADT ZÜRICH
- **EC** [DIE] EISENBAHN
- **FAN** FEUILLE D'AVIS DE NEUCHÂTEL
- **FE** FÖIGL D'ENGIADINA
- **GR** GRÜTLIANER
- **ISHZ** ILLUSTRIRTE SCHWEIZERISCHE HANDDWERKER-ZEITUNG
- **LC** LE CONFÉDÉRÉ DE FRIBOURG
- **LS** LA SUISSE
- **NZZ** NEUE ZÜRCHER ZEITUNG
- **SBZ** SCHWEIZERISCHE BAUZEITUNG
- **SHAB** SCHWEIZERISCHES HANDELSAMTSBLATT
- **SPZ** SCHWEIZERISCHE POLYTECHNISCHE ZEITUNG
- **TWB** THUNER WOCHENBLATT
- **ZF** ZÜRCHERISCHE FREITAGSZEITUNG
- **ZO** ZÜRCHER OBERLÄNDER

Bibliography

[BE95] BENDER, WILLI F. (1995): Lexikon der Ziegel. Vom Aal-Deckenziegel bis zum Zwischenwandziegel in Wort und Bild. 2. Auflage, Bauverlag GmbH, Wiesbaden und Berlin.

[BE04] BENDER, WILLI F. (2004): Vom Ziegelgott zum Industrieelektroniker. Geschichte der Ziegelherstellung von den Anfängen bis heute. Bundesverband der Deutschen Ziegelindustrie, Bonn.

[BO68] BODMER-HUBER, ERNST/MESSERLI-BOLLIGER, BARBARA E. (1968): Die Tonwarenfabrik Bodmer in Zürich-Wiedikon, Geschichte, Produktion, Firmeninhaber, Entwerfer. Mitteilungsblatt Keramikfreunde der Schweiz 101, 1–60.

[CAT94] CATALOG UND PREIS-CURRENT (1894): Mechanische Falzziegel- und Backstein-Fabriken in Altkirch und Dammerkirch. Gebrüder Gilardoni in Altkirch (Elsass) (1835–1894), Erfinder der Falzziegel. Altkirch.

[COH22] COHEN, KIM M./HARPER, DAVID A. T./GIBBARD, PHILIP L. (2022): ICS International Chronostratigraphic Chart 2002/10. International Commission on Stratigraphy, IUGS, `www.stratigraphy.org` (visited 2023/08/12).

[CUA00] CUANOUD, BORIS (2000): Stabilisation et valorisation de boues galvaniques riches en chrome dans une argile par cuisson à haute température. Unpublished diploma Thesis. Institute of Mineralogy and Petrography, University of Freiburg, Switzerland.

[ES71] ESCHER VON DER LINTH, ARNOLD/BÜRKLI, ARNOLD (1871): Die Wasserverhältnisse der Stadt Zürich und ihrer Umgebung. Zürich.

[ET77] ETTER, PAUL (1977): Alt-Wiedikon. Von Au bis Ziegelhütten. Wiedikon.

[FR52] FREI, KARL (1952): Die Keramik an den schweizerischen Industrie- und Gewerbeausstellungen in Bern 1848 und 1857, Teil II. Mitteilungsblatt Freunde der Schweizer Keramik 21, 3–6.

[FÜR93] FÜRST, DANIEL (1993): Ziegeleirohstoffe und Phonolithzusatz. Unpublished diploma Thesis. Institute of Mineralogy and Petrography, University of Freiburg, Switzerland.

[FÜR98] FÜRST, DANIEL (1998): Verwertung von wenig belasteten, anorganischen Abfallstoffen in grobkeramischen Baustoffen. Unpublished PhD Thesis. Institute of Mineralogy and Petrography, University of Freiburg, Switzerland.

[GIA01a] GIACOMINI, FOLCO (2001a): The Roman stamped tiles of Vindonissa (Northern SWITZERLAND): Provenance and technology of production. Unpublished PhD Thesis University of Fribourg, Switzerland.

[GIA01b] GIACOMINI, FOLCO (2001b): The Roman tile-factories in Switzerland: the case of the Vindonissa legionary camp (1st Century A.D.). In: Di Pierro, Simone/Serneels, Vincent/Maggetti, Marino (Eds.) Proceedings of the 6^{th} European Meeting on Ancient Ceramics, Ceramic in the Society, Fribourg, 145–162.

[GIA05] GIACOMINI, FOLCO (2005): The Roman Stamped Tiles of Vindonissa (1st Century A.D., Northern Switzerland) Provenance and technology of production – an archaeometric study. BAR International Series 1449, London.

[GU62] GUYER, PAUL/HEFTI, FRANZ (1962): Zürcher Ziegeleien 1912–1962. Zürich.

[HAR83] HARDMEYER-JENNY, JAKOB (1883): Officieller Katalog der vierten schweizerischen Landesausstellung Zürich 1883. 2. Auflage. Zürich.

[HA40] HAUPTKATALOG (1940): Zürcher Ziegeleien A. G. 1865–1940. Zürich

[HA51] HAUPTKATALOG (1951): Mauersteine, Spezialitäten, Dachziegel. Zürcher Ziegeleien, Aktiengesellschaft Zürich. Zürich

[HEI14] HEIMANN, ROBERT B./MAGGETTI, MARINO (2014): Ancient and Historical Ceramics: Materials, Technology, Art, and Culinary Traditions. Schweizerbart Science Publishers, Stuttgart.

[HE93] HERMANN, CLAUDIA (1993): Das Zieglerhandwerk in der Schweiz. Begleittext zur Wanderausstellung des Ziegelei-Museums Cham (1993–1995). Bericht der Stiftung Ziegelei-Museum 10, 5–26.

[IBE71] IBERG, ROLF (1971): Beitrag zur Thermochemie von Ziegelton. Tonindustrie-Zeitung 95, 3, 79-81.

[IBE72] IBERG, ROLF/PETERS TJERK/MUMENTHALER, THOMAS (1972): Beitrag zur Thermochemie von Ziegelton. Tonindustrie-Zeitung 96, 2, 34-37.

[KA99] KÄSER, PIUS (1999): Ein altes Handwerk. Von Zieglern und Ziegeleien. Freiburger Volkskalender, 103–107.

[KO84] KOCH, ALEXANDER (1884): Schweizerische Landesausstellung Zürich 1883. Bericht über Gruppe 17: Keramik. Zürich.

[KRE85] KREIMEYER, ROLF (1985): Zur Entstehung heller Brennfarben bei eisenhaltigen Ziegelrohstoffen. Geologisches Jahrbuch, D 75, 89-122.

[LU12] LÜÖND, KARL (2012): Loslassen und Anpacken. Hundert Jahre Wandel und Innovation. Von den Zärcher Ziegeleien zur Conzetta. Verlag NZZ. Zürich.

[LU07a] LUGEON, MAURICE (1907a): Zürich, Dampfziegelei Heurieth. In: LETSCH, EMIL (Ed), Die Schweizerischen Tonlager, herausgegeben von der Schweiz. Geotechnischen Kommission. I. Geologischer Teil. III. Abschnitt. Die Tonlager im Kanton Zürich. Beiträge zur Geologie der Schweiz, Geotechnische Serie, IV. Lieferung. Bern, Francke, 415–417.

[LU07b] LUGEON, MAURICE (1907b): Zürich, Mechanische Backsteinfabrik Zürich. In: LETSCH, EMIL (Ed.), Die Schweizerischen Tonlager, herausgegeben von der Schweiz. Geotechnischen Kommission. I. Geologischer Teil. III. Abschnitt. Die Tonlager im Kanton Zürich. Beiträge zur Geologie der Schweiz, Geotechnische Serie, IV. Lieferung. Bern, Francke, 418–425.

[LU07c] LUGEON, MAURICE (1907c): Altstetten. In: LETSCH, EMIL (Ed.), Die Schweizerischen Tonlager, herausgegeben von der Schweiz. Geotechnischen Kommission. I. Geologischer Teil. III. Abschnitt. Die Tonlager im Kanton Zürich. Beiträge zur Geologie der Schweiz, Geotechnische Serie, IV. Lieferung. Bern, Francke, 365–366.

[MAG89] MAGGETTI, MARINO (1989): Porosität, Magerungsbestandteile und Gefüge. In: SCHNEIDER, GERWULF (Red.) Naturwissenschaftliche Kriterien und Verfahren zur Beschreibung von Keramik. Acta Praehistorica et Archaeologica 21, 24-26.

[MAF93] MAGGETTI, MARINO/PFEIFER, HANS RUDOLF (1993): Analysen von 7 Tonproben der Grabung Kaiseraugst/ im Liner 1992.11. In: U. Müller (Hsg): Ausgrabungen in Kaiseraugst im Jahre 1992. Jahresberichte aus Augst und Kaiseraugst 14, 131–133.

[MAG93] MAGGETTI, MARINO/GALETTI, GIULIO (1993): Die Baukeramik von Augusta Raurica – eine mineralogisch-chemisch-technische Untersuchung. Jahresberichte aus Augst und Kaiseraugst 14, 199–225.

[MAG01] MAGGETTI, MARINO (2001): Chemical Analyses of Ancient Ceramics: What for? Art and chemical sciences 55, 11, 923–930.

[MAG09] MAGGETTI, MARINO (2009): Neolithic pottery from Switzerland: raw materials and manufacturing processes. In: SHORTLAND, ANDREW J./FREESTONE, IAN C./REHREN, THILO (eds.): From Mine to Microscope, Advances in the Study of Ancient Technology. Oxbow Books, 29-42.

[MAG20] MAGGETTI, MARINO/GALETTI, GIULIO (2020): Dachziegel der freiburgischen Ziegeleien Düdingen, Le Mouret und Corbières – chemische, geologische und historische Aspekte. Bulletin de la Société Fribourgeoise des Sciences Naturelles 109, 40-104.

[MAG22] MAGGETTI, MARINO/GALETTI, GIULIO (2022): Berner Ziegel in und um den Kanton Freiburg: eine geschichtliche und naturwissenschaftliche Untersuchung. Bulletin de la Société Fribourgeoise des Sciences Naturelles 111, 44–115.

[MAG23] MAGGETTI, MARINO/GALETTI, GIULIO (2023): The Allschwil and Laufen tileworks (Canton Basel-Landschaft) – some historical and scientific aspects. Bulletin de la Société Fribourgeoise des Sciences Naturelles 112, 123–178.

[MEY84] MEYER, CHRISTOPH/KAUFMANN, BEAT/KELLER, H. J. (1984): Das Mikrogefüge grobkeramischer Scherben. Beiträge zur Geologie der Schweiz, Geotechnische Serie 63, 1-136.

[MEY03] MEYER, CHRISTOPH (2003): Die Farben des Tons. Ziegelei-Museum 20, 23-32.

[MEY06] MEYER-FREULER, CHRISTINE/MAGGETTI, MARINO/HÄNGGI, RENE (2006): Die gestempelten Ziegel von Vindonissa – ein Beitrag der Archäometrie (Folco Giacomini). Eine Zusammenfassung der Forschungsgeschichte und der Dissertation von Folco Giacomini. Jahresbericht der Gesellschaft Pro Vindonissa 45–55.

[MUM95] MUMENTHALER, THOMAS/SCHMITT, HERBERT/PETERS, TJERK/RAMSEYER, KARL/ZWEILI, FRED (1995): Verfolgung der Reaktionsvorgänge beim Brennen von karbonathaltigen Ziegelmischungen mit Hilfe der Kathodenlumineszenz. Ziegelindustrie International 48, 5, 307-318.

[MUM97] MUMENTHALER, THOMAS/MEYER, CHRISTOPH/SIGG, JEAN (1997): Rohstoffe für die Ziegelindustrie. In: KÜNDIG, RAINER/MUMENTHALER, THOMAS/ECKARDT, PETER/KEUSEN, HANS RUDOLF/ SCHINDLER, CONRAD/HOFMANN, FRANZ/ VOGLER, RUDOLF/GUNTLI, PETER, Die mineralischen Rohstoffe der Schweiz. Schweizerische Geotechnische Kommission, Zürich, 23–63.

[NOL88] NÖLLER, RENATE /KNOLL, HEINZ (1988): The yellow colouration of oxidized burned ceramics. Berliner Beiträge zur Archäometrie 10, 107-112.

[OR01] ORTSMUSEUM WIEDIKON (2001): Backsteinfabrik. Neujahrsblätter, Wiedikon.

[PA15] PAVONI, NAZARIO / SCHINDLER, CONRAD / FREIMOSER, MATTHIAS / HALDIMANN, PETER / LETSCH, DOMINIK (2015): Blatt 1091 Zürich. Geol. Atlas Schweiz 1: 25 000, Erläut. 90.

[PET73] PETERS, TJERK/JENNI, JEAN-PIERRE (1973): Mineralogische Untersuchung über das Brennverhalten von Ziegeltonen. Beiträge zur Geologie der Schweiz, Geotechnische Serie 50, 1-59.

[PET78] PETERS, TJERK/IBERG, ROLF (1978): Mineralogical changes during firing of calcium-rich clays. American Ceramic Society Bulletin 57, 5, 503-506.

[RI02] RINDLISBACHER, HANS (2002): Verdecktes und Verdrehtes aus dem Leben des Solothurner Zeichenlehrers und Graphikers Rolf Puschmann (1846–1914). Jahrbuch für Solothurnische Geschichte 75, 179–222.

[WO99] WOLF, SOPHIE (1999): The bricks from St. Urban: analytical and technical investigation on Cistercian bricks in Switzerland. Unpublished PhD Thesis, University of Fribourg, Switzerland.

[WO02a] WOLF, SOPHIE (2002a): Estimation of the production parameters of very large Medieval bricks from St. Urban, Switzerland. Archaeometry 44,1, 37–65.

[WO02b] WOLF, SOPHIE (2002b): Chemical and petrographical distinction between three Medieval brick productions in Switzerland. In: JEREM, ERSZEBET/BIRO, KATALIN F. (Eds.) Proceedings oft the 31th International Symposium on Archaeometry. Archaeopress –Archaeolingua BAR–Centr. Eur. Ser. 1, 257–261.

[WO03] WOLF, SOPHIE (2003): Naturwissenschaftliche Untersuchungen zur Herstellungstechnik der Backsteine von St. Urban. In: BADSTÜBNER, ERNST/SCHUMANN, DIRK (Eds.) Backsteintechnologien in Mittelalter und Neuzeit. Studien zur Backsteinarchitektur 4, Berlin, 239–258.

[WO04] WOLF, SOPHIE/SUTER, PETER/MAGGETTI, MARINO (2004): Villa romana: Dachziegel des L. C. Priscus. In: SUTER, PETER J. ET AL. (Hsg.) Meikirch Villa romana, Gräber und Kirche, 74–84.

[WY97] WYDER, LEEMANN, ELISABETH/WYDER-LEEMANN, SAMUEL (1997): Planaufnahmen um die Stadt Zürich an der Wende vom Ancien Régime zum modernen Staat. Cartographica Helvetica 16, 20–21, Abb. 9.

[ZU87] ZÜRCHER ZIEGELEIEN (1987): 75 Jahre Zürcher Ziegeleien. Die Zürcher Ziegeleien, gestern, heute, morgen. Zürich.

[ZSC07] ZSCHOKKE, B. (1907): Die schweizerischen Tonlager, II. Technologischer Teil. Technologische Untersuchung der schweiz. Tone ausgeführt in der Eidgenössischen Materialprüfungsanstalt am Schweiz. Polytechnikum. Beiträge zur Geologie der Schweiz, Geotechnische Serie, IV. Lieferung. Bern, Francke.

Maps

[BR94] BREITINGER, DAVID (1894): Plan de la Ville et des Environs de Zürich. Collection Ryhiner, Universitätsbibliothek Bern, https://doi.org/10.3931/e-rara-116671.

[GR60] GROSS, [RUDOLF] (Ca. 1860): Plan der Stadt Zürich und ihrer Umgebungen. Plan de la Ville de Zurich et de ses environs. Mit Angabe von Gebäuden, Promenaden und Vergnügungsorten mit schöner Aussicht ausserhalb der Stadt. Stich BRESSANINI, RINALDO. Editeur LEÜTHOLD, H. F. vis-à-vis des Postes à Zurich. 1:13'500. Staatsarchiv des Kantons Zürich, Plan C 79.

[HI85] HIRZEL, HANS CASPAR (1785-1790): Wiedikon und Aussersihl: Vermessung der Gemeinden. Staatsarchiv Zürich, Plan (Dossier) B 451.

[PA92] PAVONI, NAZARIO/JÄCKLI, HEINRICH/SCHINDLER, CONRAD (1992): Blatt 1091 Zürich. Geol. Atlas Schweiz 1: 25 000, Karte 90.

Birds-eye view

[MA13] MAGGINI, GIOVANNI (ca. 1913): Vogelschau-Karte von Zürich u. Umgebung. Frobenius, Basel.

Internetressources

[FY23] FYRAABIG-ZIEGEL (2023): www.zz-ag.ch/news/feierabendziegel-2023, ZÜRCHER ZIEGELEIEN AG, accessed 26.03.2025.

[HE41] HERMANN, FRITZ: Johann Rudolf Ringger (1841–1908) Leben und Werk. www.ortsgeschichte-kuesnacht.ch, accessed 11.04.2025.

[HU15] HUBLER, LUCIENNE (2015): "Ziegelei". Historisches Lexikon der Schweiz (HLS), 19.05.2015, translated from the French version. Online: https://hls-dhs-dss.ch/de/articles/014018/2015-05-19/, accessed 11.04.2025.

[IL15] ILLI, MARTIN (2015): "Wiedikon". Historisches Lexikon der Schweiz (HLS), 11.01.2015. Online: https://hls-dhs-dss.ch/de/articles/003132/2015-01-11/, accessed 26.04.2025.

[OR25] ORTSMUSEUM WIEDIKON (2025): Geschichte der Zürcher Ziegeleien. https://www.ortsmuseum-wiedikon.ch/wiedikon/ziegeleien, accessed 08.04.2025.

https://www.e-newspaperarchives.ch

https://www.e-periodica.ch

Appendices

Year	Heurieth		Zürich	
	Dividend (%)	Reference	Dividend (%)	Reference
1880 - 1884			3 – 4.5	DB 23.06.1885
1885			7	NZZ 22.01.1886
1889	5	NZZ 30.04.1890	9	DB 01.03.1880
1890	5	NZZ 25.03.1891	9	NZZ 12.01.1891
1891			10	ZF 11.03.1892
1892			11	DB 17.03.1893
1893	6	NZZ 17.04.1893	12	ISHZ 10.02.1894
1894			14	NZZ 13.02.1895
1895	6	DB 07.03.1897	16	NZZ 25.02.1896
1896	10	DB 07.03.1897	18	NZZ 15.01.1897
1897	12	DB 05.03.1899	16	NZZ 01.02.1898
1898	12	DB 05.03.1899	10	NZZ 06.02.189
1899	10	NZZ 16.02.1901	10	NZZ 09.02.1900
1900	5	NZZ 16.02.1901	6	NZZ 12.02.1901
1901	5	ZF 28.03.1902	5	NZZ 01.02.1902
1902	5	NZZ 09.02.1904	5	NZZ 01.02.1903
1903	5	NZZ 09.02.1904	5	NZZ 04.02.1904
1904	5	NZZ 14.02.1905	5	NZZ 08.02.1905
1905	5	NZZ 19.02.1906	5	NZZ 24.01.1906
1906			7	NZZ 24.01.1907, 25.01.1907
1907			8	NZZ 29.01.1908
1908			6	NZZ 02.02.1909

Table 5.2: *«Heurieth» and «Zürich» sharehoder's dividends of the years 1880–1908.*

Clay pit, an. no.	**No. in Lugeon (1907)** [LU07a, LU07b, LU07c]	**Analytical results**							
		SiO_2	Al_2O_3	Fe_2O_3	$CaSO_4$	CaO	MgO	$Na_2O + K_2O$	**Total**
Heurieth									
A	11	55.96	19.99	5.19	1.08	14.42	2.31	1.95	100.90
B	12	49.36	19.89	4.54	1.21	20.82	2.06	2.12	100.00
C	13	51.00	19.29	4.73	1.97	18.69	2.96	1.36	100.00
D	14	48.86	19.85	3.83	1.48	22.59	2.49	0.90	100.00
Binz									
E	1	56.90	18.63	5.44	0.98	11.11	4.30	2.61	99.97
F	2	48.80	20.13	4.84	1.35	20.65	3.24	1.00	100.01
G	3	46.99	18.28	4.87	1.25	25.48	3.08	0.01	99.96
H	4	46.79	20.07	4.38	1.41	23.76	2.64	0.95	100.00
I	5	49.03	18.75	3.87	0.48	24.59	2.73	0.55	100.00
Tiergarten									
K	6	53.48	21.55	5.58	1.72	15.34	2.42	0.21	100.30
L	7	50.73	20.09	4.53	1.42	17.23	4.91	1.09	100.00
M	8	48.20	20.86	4.40	1.20	21.64	2.48	1.22	100.00
N	9	51.14	19.48	4.82	1.08	19.83	2.64	1.01	100.00
O	10	49.80	19.18	5.26	1.03	18.02	5.26	1.55	100.10
Herdern									
	15	70.96	16.43	3.61	0.49	4.74	2.36	1.41	100.00
	16	67.23	17.94	4.19	0.68	5.24	2.62	2.10	100.00

Table 5.3: *Analytical results (wt.%) of clays and clay mixtures from the open pits of three mechanical brick- and tileworks in Wiedikon [ZSC07, 132]. For the methodology, see* Zschokke *[ZSC07, 2-8].*

An. no.	**Type**	**Year**	**Place of finding, coordinates**
ZZ 68	1	1887	Ronco sopra Piotta, 2’612’300/1’148’600
ZZ 179	3		Zelg, N of Ueberstorf, 2’589’900 / 1’191’850
ZZ 180	3		"" "" ""
ZZ 181	3		"" "" ""
ZZ 182	3		"" "" ""
ZZ 183	3		"" "" ""
ZZ 184	3		"" "" ""
ZZ 185	3		"" "" ""
ZZ 186	3		"" "" ""
ZZ 187	3		"" "" ""
ZZ 188	3		"" "" ""
ZZ 189	3		"" "" ""
ZZ 190	3		"" "" ""
ZZ 191	3		"" "" ""
ZZ 192	3		"" "" ""
ZZ 193	3		"" "" ""
ZZ 280	1	1887	Haltli E Oberwil, Simmental, 2’600’000 - 2’100’000 / 1’167’000 - 1’800’000
ZZ 281	2	1907	"" "" ""
ZZ 282	2	1915	"" "" ""
ZZ 329	2	1906	Örtli, Gunten, 2’619’300/1’174’010
ZZ 333	?		"" "" ""
ZZ 334	?		"" "" ""
ZZ 448	1	1885	Zuchwil, Canton Solothurn
ZZ 449	1	1885	"" "" ""

Table 5.4: *Sample list.*

An. No.	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	MnO	MgO	CaO	Na_2O	K_2O	P_2O_5	SUM	Ba	Cr	Cu	Nb	Ni	Pb	Rb	Sr	V	Y	Zn	Zr	LOI
ZZ 68	61.55	0.73	15.23	5.39	0.08	5.01	9.11	0.55	2.46	0.11	100.22	293	139	9	13	87	43	127	145	108	34	67	154	0.73
ZZ 179	66.05	0.76	15.07	5.63	0.09	3.96	5.35	0.65	2.45	0.11	100.24	311	136	30	16	79	34	148	119	108	35	96	210	0.74
ZZ 180	65.63	0.76	15.29	5.68	0.10	4.01	5.50	0.60	2.45	0.10	100.12	317	135	31	18	78	36	149	124	106	34	104	200	0.51
ZZ 181	65.88	0.75	14.92	5.52	0.09	3.88	5.89	0.63	2.39	0.11	100.06	319	133	33	14	74	29	140	128	109	36	89	209	0.85
ZZ 182	68.76	0.77	14.39	5.36	0.08	2.81	5.04	0.76	2.22	0.10	100.29	300	119	26	16	62	27	137	133	106	34	83	237	1.61
ZZ 183	68.44	0.74	14.27	5.30	0.08	3.31	4.91	0.73	2.21	0.12	100.11	323	122	27	16	69	30	134	121	106	36	84	234	0.70
ZZ 184	63.61	0.71	14.62	5.56	0.10	4.77	7.57	0.57	2.41	0.12	100.04	299	128	32	15	78	34	140	140	112	34	85	195	0.64
ZZ 185	65.37	0.75	15.31	5.52	0.08	4.04	5.82	0.60	2.47	0.11	100.07	304	135	32	16	79	37	148	130	108	35	177	205	0.44
ZZ 186	69.06	0.77	14.49	5.20	0.07	2.87	4.59	0.77	2.27	0.10	100.19	315	126	25	17	61	36	143	131	104	35	89	239	1.09
ZZ 187	66.68	0.75	15.14	5.59	0.09	3.67	5.14	0.66	2.38	0.11	100.20	321	134	29	14	74	36	145	122	113	34	92	216	0.66
ZZ 188	69.13	0.74	14.21	4.99	0.06	2.89	5.17	0.78	2.15	0.11	100.23	321	133	27	17	62	33	130	132	105	37	81	239	1.43
ZZ 189	66.19	0.77	15.21	5.90	0.10	3.71	5.06	0.63	2.41	0.11	100.09	317	131	30	16	78	30	144	121	103	35	95	208	0.41
ZZ 190	67.02	0.74	14.30	5.37	0.09	3.75	5.84	0.70	2.27	0.12	100.20	306	126	28	15	70	25	132	130	100	35	84	231	0.59
ZZ 191	68.54	0.76	14.40	5.07	0.07	2.88	5.39	0.75	2.24	0.10	100.20	322	121	28	15	63	36	138	137	99	35	84	238	1.69
ZZ 192	65.51	0.74	14.95	5.59	0.09	4.00	6.07	0.62	2.39	0.11	100.07	312	127	35	16	75	29	141	126	112	33	94	207	1.02
ZZ 193	67.75	0.75	14.59	5.41	0.09	3.50	4.95	0.72	2.29	0.11	100.16	314	132	28	16	71	34	137	122	100	37	88	227	0.41
ZZ 280	60.59	0.67	15.21	5.45	0.09	5.27	9.55	0.31	2.36	0.11	99.61	292	139	35	14	88	25	142	159	110	34	92	170	0.75
ZZ 281	65.74	0.74	15.17	5.63	0.09	3.70	5.85	0.49	2.21	0.12	99.74	310	140	31	15	80	27	142	139	97	34	132	205	0.50
ZZ 282	60.59	0.57	14.29	4.88	0.11	5.23	10.18	0.68	2.86	0.11	99.50	329	115	30	14	75	21	155	155	85	29	128	163	0.33
ZZ 329	65.50	0.73	14.65	5.36	0.08	3.98	6.75	0.65	2.37	0.11	100.18	301	119	35	15	71	26	143	139	107	34	163	191	0.93
ZZ 333	65.09	0.72	14.67	5.33	0.08	4.18	7.04	0.61	2.37	0.11	100.20	287	126	32	15	73	21	143	139	110	33	163	190	0.44
ZZ 334	65.25	0.71	14.63	5.32	0.08	4.09	6.83	0.63	2.38	0.10	100.02	302	125	34	15	73	22	141	137	109	33	170	186	0.67
ZZ 448	60.41	0.75	15.23	5.65	0.09	4.91	9.09	0.49	2.57	0.13	99.30	263	127	38	14	80	56	144	158	119	31	99	149	0.77
ZZ 449	59.98	0.72	14.76	5.56	0.10	5.11	9.84	0.49	2.53	0.12	99.22	274	140	41	14	82	52	143	167	132	30	95	148	1.58

Table 5.5: *XRF analytical results of 24 roof tiles from the «Mechanische Backsteinfabrik Zürich». Oxides, totals and losses on ignition (LOI) in wt. %, trace elements in ppm.*

System / Period	**Series / Epoch**	**Stage / Age**	**Factory**
Quaternary	Holocene & Pleistocene	Holocene / Upper Pleistocene	Allschwil (Aktien Ziegelei)
			Allschwil (Passavant-Iselin)
			Corbières
			Düdingen
			Eymatt/Tiefenau
			Le Mouret
			Lyss
			Thun
			Zollikofen
Neogene	Miocene	Aquitanian	Langenthal
			Pieterlen
			Rapperswil
			Roggwil
			Schüpfen
Paleogene	Oligocene	Rupelian	Allschwil (Aktien Ziegelei)
			Allschwil (Passavant-Iselin)
			Laufen

Table 5.6: *Stratigraphic position of the raw materials from 15 previously analysed Swiss brick- and tile-factories of this ongoing project. Simplified from* C*OHEN* & C*IE [COH22].*