



**OTTO AMPFERER (1875–1947):
PIONEER IN GEOLOGY, MOUNTAIN CLIMBER, COLLECTOR AND DRAFTSMAN**

**OTTO AMPFERER (1875–1947):
BAHNBRECHER IN DER GEOLOGIE, BERGSTEIGER, SAMMLER UND ZEICHNER**

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Mit 21 Abbildungen / with 21 figures

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Zusammenfassung

Otto Ampferer war ein großartiger Geologe, der, basierend auf seiner reichen Geländeerfahrung in den Nördlichen Kalkalpen, eine Reihe neuer Ideen und Konzepte entwickelte, insbesondere auf dem Gebiet der Strukturgeologie und Gebirgsbildung. Er erkannte die Karwendelüberschiebung und entwickelte unter anderem Vorstellungen über die Reliefüberschiebung, Unterströmung und Totfaltung. Außerdem erkannte er bereits das Grundprinzip der Plattentektonik.

Ampferer war auch ein ausgezeichnete Bergsteiger. Während seiner Studienzeit an der Universität Innsbruck gelang ihm mit Freunden eine Reihe von Erstbesteigungen bekannte Gipfel im Karwendel und in der Mieminger Kette. Eine herausragende bergsteigerische Leistung war die Erstbesteigung der Guglia di Brenta gemeinsam mit Karl Berger und Wilhelm Hammer.

Ampferer hinterließ eine umfangreiche Sammlung von Fotos und Ansichtskarten mit verschiedenen Ansichten von Tirol und dem Balkan sowie von verschiedenen kunsthistorisch interessanten Objekten. Letztendlich war Ampferer auch ein sehr guter Zeichner, der hauptsächlich geologische, aber auch nicht-geologische Motive in seinen Zeichnungen festhielt.

Abstract

Otto Ampferer was a great geologist who introduced a number of new ideas and concepts, particularly in the field of structural geology and mountain building processes, mainly based on his extensive field experiences in the Northern Calcareous Alps (e. g. articles entitled *“Beiträge zur Auflösung der Mechanik der Alpen”* (1923–1931)). He recognized the *Karwendelüberschiebung* (Karwendel overthrusting), and developed, among others, the concepts of the *Reliefüberschiebung* (relief overthrusting), *Unterströmung* (undercurrents) and *Totfaltung* (dead folding). He also recognized the principles of plate tectonics.

Ampferer was an excellent mountain climber and during his years of study at the University of Innsbruck he made together with his friends a number of first ascents of well-known peaks in the Karwendel and Mieminger mountain ranges. An outstanding mountaineering achievement was the first ascent of the famous Guglia di Brenta, together with Karl Berger and Wilhelm Hammer.

Ampferer left an extensive collection of photographs and post cards of Tyrol and the Balkans as well as of various interesting art-historically objects. Ampferer was also a very good draftsman, drawing mostly geological, but also non-geological subjects.



Fig. 1: The young Otto Ampferer (photo taken around 1900).



Fig. 3: House in Hötting/Innsbruck where Ampferer was born.



Fig. 2: Ampferer's official identity card issued by the „Reichsstelle für Bodenforschung, Zweigstelle Wien“ in 1939.

Otto Ampferer

Otto Ampferer (Fig. 1, 2) was born in Hötting/Innsbruck (Fig. 3) on December 1, 1875. During his time at secondary school Ampferer was strongly influenced by his teacher Johann Schuler. Schuler taught Latin and Greek but was also interested in science and he sparked Ampferer's interest in natural sciences, and in particular for geology.



Fig. 4: Otto Ampferer (left) and his friend Wilhelm Hammer.

When Schuler built the big relief of Tyrol, Ampferer delivered the different rock types.

At the University of Innsbruck Ampferer studied mathematics, physics and above all geology. Together with his friend Wilhelm Hammer (Fig. 4) he had concluded his Ph.D. study after only eight semesters with a thesis about the geology of the southern Karwendelgebirge, and in 1899 has received the doctorate. The thesis was distinguished with the Prize of the University of Innsbruck. In 1901 he entered into the service of the Geologische Bundesanstalt (Geological Survey of Austria), at that time "k.k. Geologische Reichsanstalt".

In 1902 he married Olga Sander (Fig. 5), the sister of the famous Bruno Sander. Ampferer was director of the *Geologische Bundesanstalt* (Austrian Geological Survey) from 1935 to 1937. Ampferer died in Innsbruck on July 9, 1947.

Ampferer as geologist

Ampferer was a great field geologist. Starting from the Karwendel, the mountains north of Innsbruck, he had begun to map the Northern Calcareous Alps to the west and the east and, in the end, he had mapped the whole Tyrolean and Vorarlberg part of the Northern Calcareous Alps, partially in form of geologic special maps by order of the D.u.Ö.A.V. (German and Austrian Alpine Club). These maps were drawn at a scale of 1: 25.000, and they represent a highlight of geological mapping of the Alps (Fig. 6).

Ampferer made important contributions to stratigraphy, in particular to the structural geology (*Deckentektonik*) of the Northern Calcareous Alps (Fig. 7). Already in 1901 he recognized the "Karwendelüberschiebung" (Karwendel overthrusting) and in 1906 he set up the *undercurrent theory* (*Unterströmung*; 1906, 1939), based on his experiences and observations in the field. When Ampferer realized that the driving forces for the transportation of nappes over distances of more than 100 km could not be derived from the crust, he developed the idea that flowing processes deeper in the earth must be the reason for the deformation and mountain building processes within the crust. He named these flowing processes "*Unterströmung*" (undercurrents). Later Ampferer (1911) developed the concept of the "*Verschluckungszone*". He suggested that there are zones in the crust, where parts of the



Fig. 5: Olga Ampferer, the sister of Bruno Sander.



Fig. 6: Detail from the Geological Map of the Lechtal Alps (Parsseierspitzgruppe, 1:25.000, published in 1928 by the D.u.Ö.A.V.).

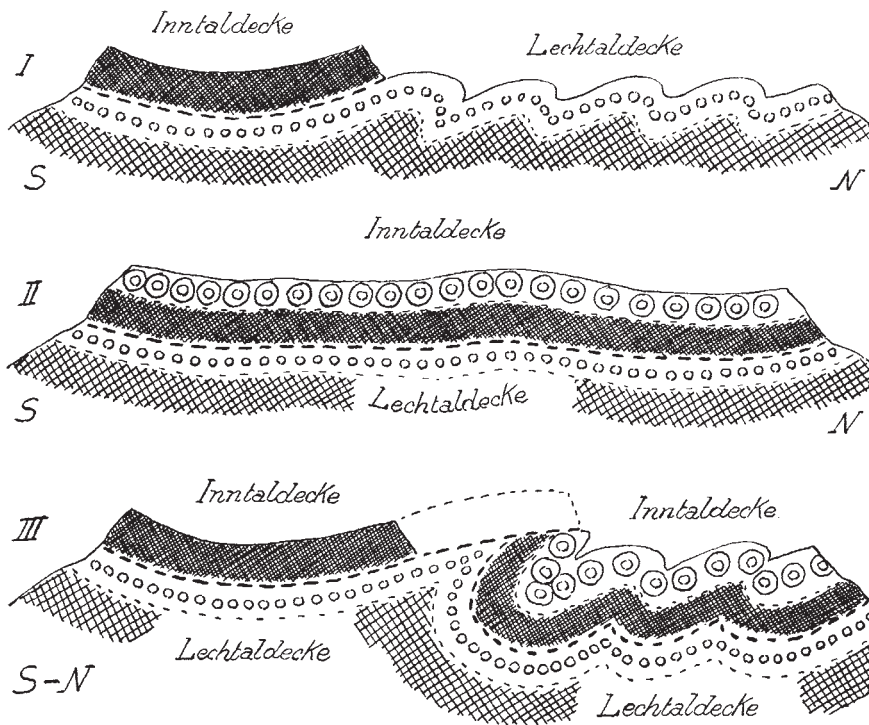


Fig. 8. Innthaldecke = dichtes Gitter = Trias, Doppelringe = Jura + Kreide, Lechtaldecke = offenes Gitter = Trias, Ringe = Jura + Kreide. I = Gliederung nach der alten Auffassung. Das Karwendel-hochgebirge besteht aus der Innthaldecke, das Karwendelvorgebirge aus der Lechtaldecke. Die verschiedene Höhenlage ergibt sich zwanglos aus der Auflagerung der Innthaldecke, ebenso auch der verschiedene Schichtenbesitz der zwei Decken. II und III = Die zwei tektonischen Phasen nach der Hypothese von M. Richter. II = weiter Vorschub der Innthaldecke über die Lechtaldecke. III = Auf-faltung eines gemeinsamen Deckensattels, Überschiebung des oberen Teiles des Südfüßels und eigene Senkung des ganzen nördlichen Gebietes. Durch diese Senkung wurden die jüngeren Schichten der Innthaldecke hier vor der Abtragung bewahrt.

Fig. 7: Ampferer's concept on the tectonic style and subdivision into nappes in the western part of the Northern Calcareous Alps, particularly in the Karwendel Mountains (from Ampferer 1931, Fig. 8).

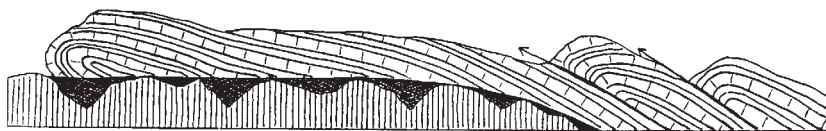


Fig. 3. Schema einer Reliefüberschiebung.

Vertikalschraffen = älteres Gebirgsrelief. Kreuzschraffen = Materialanschoppung in den überwältigten Furchen. Die Reliefschubmasse selbst ist in drei Schuppen zerlegt, die alle Stirneinrollungen zeigen.

Fig. 8: Schematic drawing of a relief overthrusting (Reliefüberschiebung) (from Ampferer 1937, Fig. 3).

crust are subducted, causing overthrusting and stacking of large sheets of the crust near the surface.

In 1928 Ampferer described the *Reliefüberschiebung* (relief overthrusting) in the Karwendel (Fig. 8), he also introduced the terms "*Totfaltung*" (dead folds; 1938) and "*Bergzerreißung*" (mountain splitting; 1939, 1949; Fig. 9). In addition, Ampferer

made important contributions to glacial geology; the idea of the so-called "*Schlußvereisung*" (final ice formation; 1930) is credited to him. A little known article with the title "*Gedanken über das Bewegungsbild des Atlantischen Raumes*" (thoughts about the geodynamics of the Atlantic space; 1941) he considers as one of his most significant works.

In this work Ampferer recognized and described the concept of plate tectonics. These ideas were developed from his undercurrent theory with aspects of the theory of convection currents by R. Schwinner, and probably also influenced by the continental movement theory of A. Wegener. In 1925–27 the German Meteor expedition in the Atlantic Ocean made the important discovery of the mid-Atlantic ridge. Ampferer (1941) explained the existence of this ridge by a continuous ascending "*aufsteigende Unterströmung*" (rising undercurrents), which "*breaks through the continental masses and drives them apart*" (Abschub der Teile nach beiden Seiten; downward movement of the parts towards both sides). Ampferer noted "*that this*

spreading involves a widening of the central ridge and that the divergent movement of the continents follows a more or less symmetrical pattern emanating from the central ridge". This clearly shows that Ampferer already recognized the mechanism of sea-floor spreading (Fig. 10). The reason for the island arcs of the Lesser Antilles and Southern Antilles Ampferer explained by "*Unterströmung*" (undercurrents) along a "*Verschluckungszone*" (= deep sea trench), demonstrating that Ampferer also real-

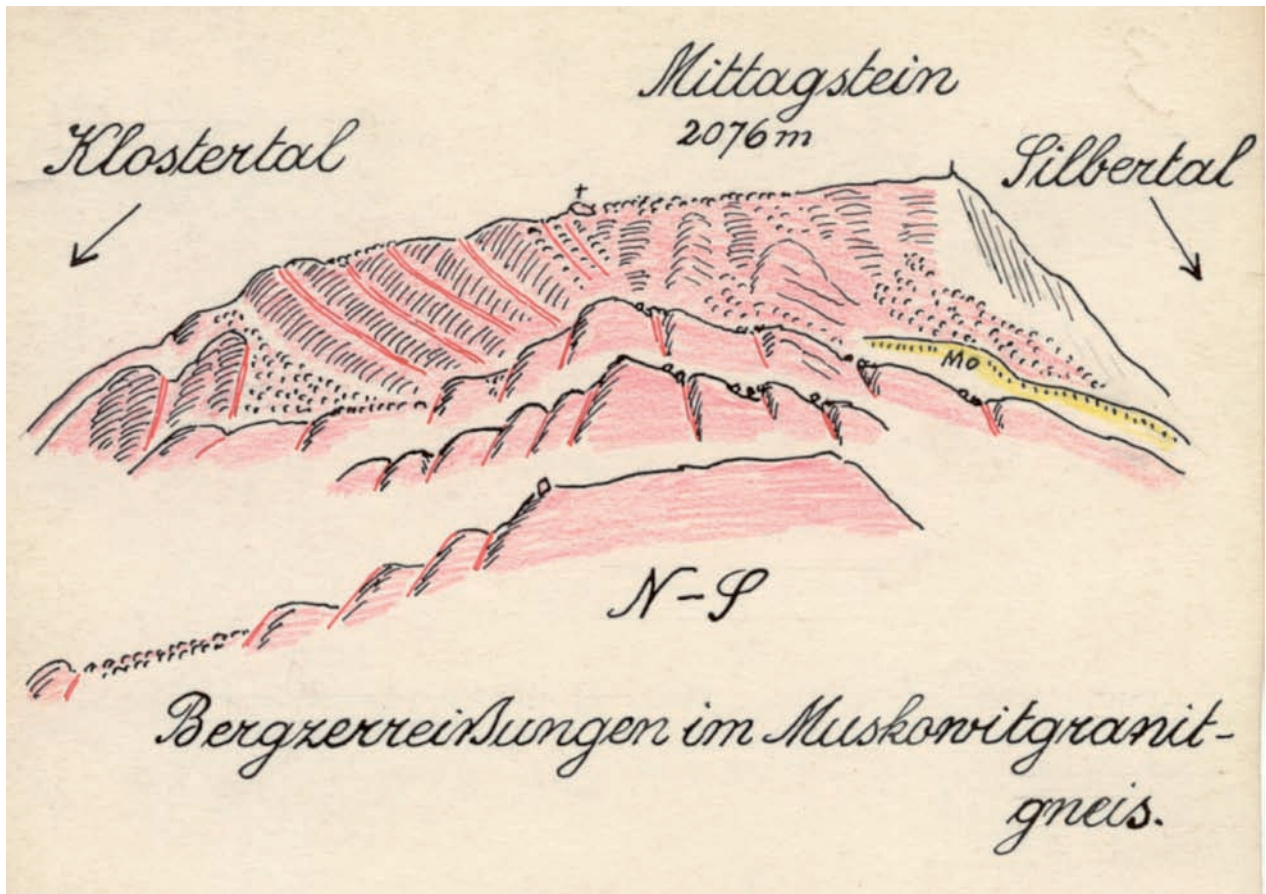


Fig. 9: An example of mountain splitting (Bergzerreißung) in metamorphic rocks of the Montafon (Vorarlberg).

Fig. 10: Ampferer (1941, Fig. 2) explained the existence of the mid-Atlantic ridge by rising undercurrents and downward movement of the two parts towards both sides.



Fig. 2. Schema der Teilung einer Kontinentmasse durch eine aufsteigende Unterströmung und Abschub der Teile nach beiden Seiten. Bei + entsteht so der atlantische Mittelrücken, welcher die Halbierung der Teilung festhält.

ized the existence of subduction zones (see Flügel 1980, 1984, 2000; Thenius 1984, 1988).

Ampferer wrote more than 400 articles, which were mostly published in Austria (above all in the journals of the Geologische Bundesanstalt; see Klebelsberg 1949), but some also in German magazines. Ampferer left more than 70 field books, most of them stored in the Archives of the Tiroler Landesmuseum Ferdinandeum (Innsbruck).

In contrast to Alfred Wegener, Ampferer was not a good public speaker and only had a few international contacts. Hence, his works and ideas were barely known abroad and were long to remain unnoticed.

Ampferer as a mountain climber

At the age of 10 Ampferer began to roam from his home in Hötting into the mountain world surrounding Innsbruck. As a 12-year-old he climbed the Brandjoch across the south ridge by himself and in company he climbed his first peaks higher than three thousand meters: Parseierspitze, Patteriol and Fluchthorn. He climbed either alone or with his best friends, above all with Wilhelm Hammer and Karl Berger. During his middle school years he spent every free day in the mountains, and between 1894 and 1902 he made a number of first ascents in the

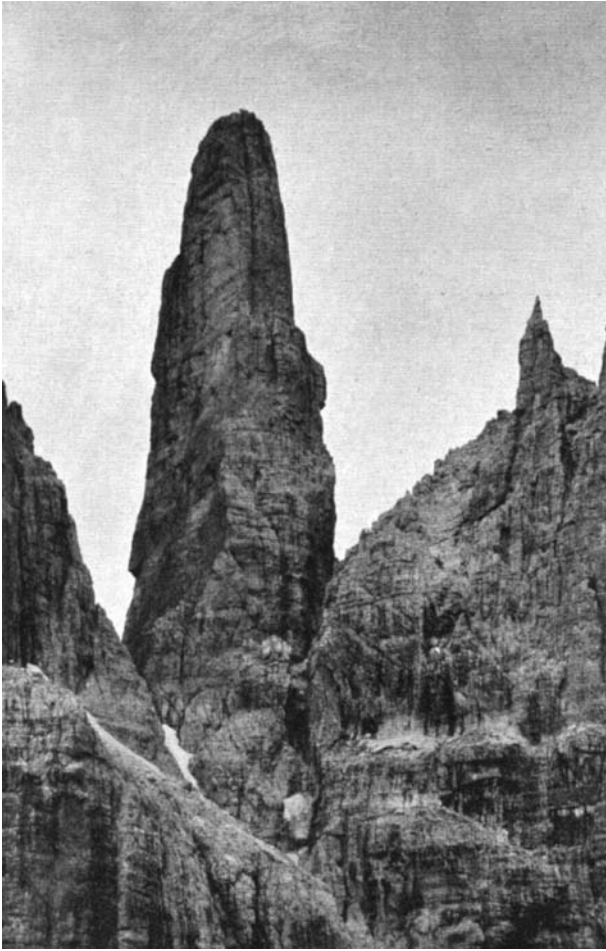


Fig. 11: Guglia di Brenta, first ascended by Ampferer, Berger and Hammer on August 18, 1899 (from Ampferer, 1930).



Fig. 12: Old door knocker (postcard collection of Ampferer).



Fig. 13: Old iron key (postcard collection of Ampferer).

Mieminger mountains (Östliche Marienspitze from the SE on October 14, 1897, Sonnenspitze on August 14, 1897, Hinterer Drachenkopf on July 16, 1898, the first ascent of the Hochplattig across the NE ridge on July 14, 1897, Hochwand across the SW ridge on September 25, 1897), in the Karwendel (Fallbachkarispitze 1894, Grubreisen-Nordturm 1894, Hallerangerspitze 1895), and in the Stubai

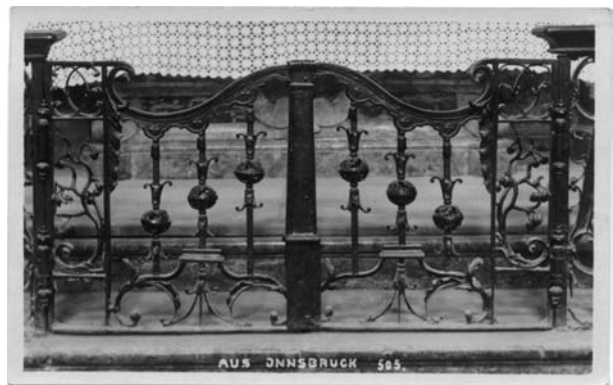


Fig. 14: Wroughtiron gate from a church in Innsbruck (postcard collection of Ampferer).

Alps (first ascent of the Habicht across the NE ridge on June 30, 1901).

On August 18, 1899, to mark the birthday of the emperor, Ampferer, together with Wilhelm Hammer



Fig. 15: Old wroughtiron grave cross (postcard collection of Ampferer).



Fig. 16: Guild sign photographed in Matrei south of Innsbruck around 1920 (postcard collection of Ampferer).



Fig. 17: Begova-mosque at Sarajevo around 1915 (postcard collection of Ampferer).



Fig. 18: This photograph, taken around 1920, shows that the Mittelberg Glacier (Pitztal; Ötztal Alps) strongly retreated since that time (postcard collection of Ampferer).



Fig. 19: The village of Sölden (Ötz Valley) around 1920. Today Sölden is one of the biggest ski tourism centres of Tyrol (postcard collection of Ampferer).

and Karl Berger, made a brilliant achievement in mountain climbing with the first ascent of Guglia di Brenta (Fig. 11). The other known summits Ampferer climbed are Sella towers (1899) in the Dolomites and Monte Rosa in Switzerland. In his report on the first ascent of the Hintere Drachenkopf in 1898, Ampferer recounts that he has constructed along with his friends special climbing shoes. These shoes were made during the preceding winter for rock climbing, because the hobnail boots usual at that time were too stiff and unsuitable for climbing. These were probably the first shoes especially made for rock climbing. In the book *"Bergtage"*, Ampferer (1930) recounts very personal descriptions of some of his most successful and interesting first ascents.

Ampferer as a collector

Ampferer left an extensive collection of photographs and postcards of Tyrol (arranged by valley, including Oberinntal, Sellrain, Ötztal, Pitztal, Kaunertal, Oberes Gericht, Paznaun, Arlberg, Wipptal, Karwendel, Achensee), Vienna and Zurich. The collection of photographs is of art-historical interest, and includes of old door knockers (Fig. 12) and keys (Fig. 13), wroughtiron gates (Fig. 14) and grave crosses (Fig. 15), signs from different professions (guilds; Fig. 16), old wooden wells, frescoes and decorated wood-raftered ceilings. Additionally, the collection contains numerous photos and postcards from Albania, Sarajevo and Belgrade, which Ampferer collected during the First World War in Albania by order of the war ministry (Fig. 17). Most of the photographs and post cards were taken between 1910 and 1935. They give an impressive view of the landscape and villages of many parts of Tyrol and the Balkans. Photographs from the Ötztal Alps, for example show how glaciers re-

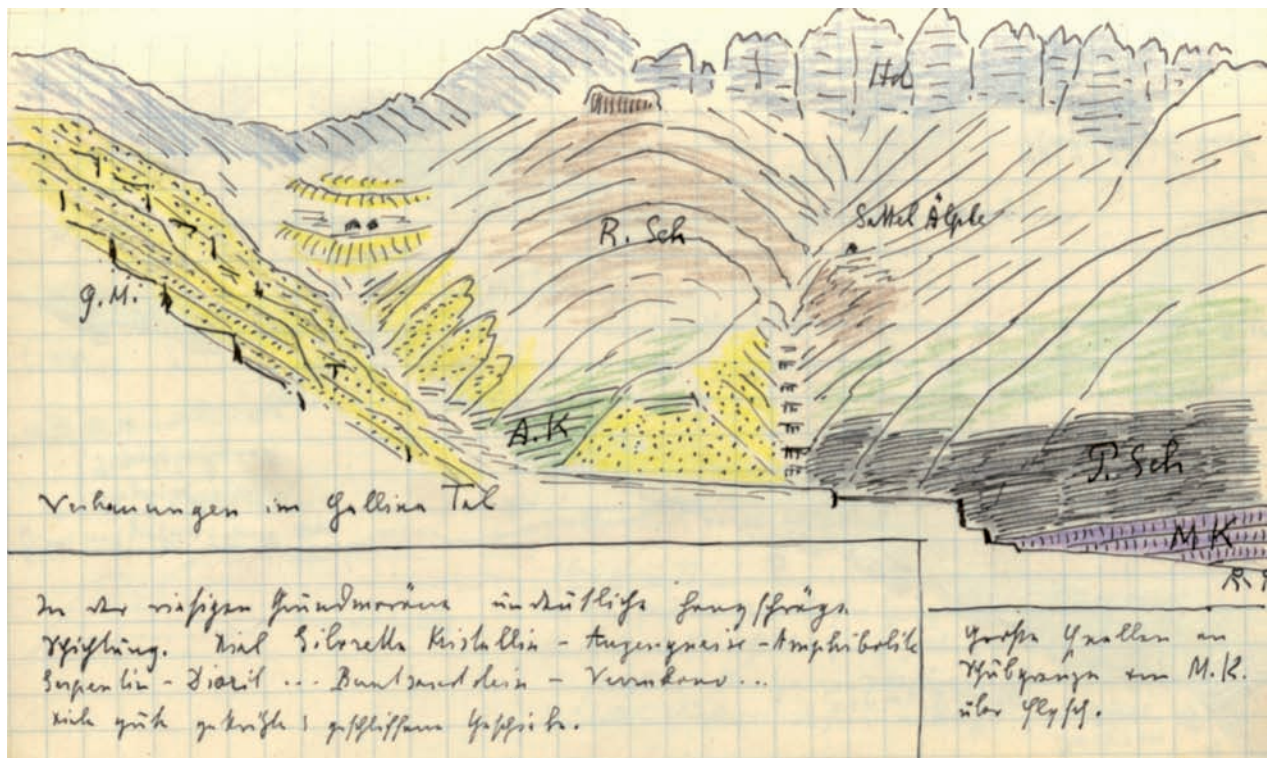


Fig. 20: Ampferer documented most of his observations in the field in the form of careful drawings like this which he made in 1936 during field work in the Northern Calcareous Alps of Vorarlberg.



Fig. 21: A tree drawn by Ampferer with black pencil on white paper.

treated during the last 100 years (Fig. 18). Some photographs also show that some of the present day tourist centres of Tyrol like Sölden (Fig. 19), Obergurgl and Serfaus, were small villages mostly inhabited by mountain farmers.

Ampferer as a draftsman

Ampferer was a very good draftsman and he produced drawings in both black pencil and with the use of colour. In his field books the main way in

which he recorded his geological observations was with the use of drawings. He showed whole mountain flanks and mountain groups with great realism and with all geologically relevant structures (Fig. 20). He also explained his tectonic hypotheses with easy, but expressive, drawings and sketches. In addition, he had a great fondness for non-geologic subjects like houses, trees, or mountains (Fig. 21).

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