the iron melting process. Such slags were extensively distributed in the surrounding environment. They are characterised by high magnetic susceptibility values (max. 3796 x 10^{-3} SI) and, thus, has a significant effect on the magnetic survey results, as well as on measurements of the electric conductivity and related parameters. The presented susceptibility models are based on an integrative interpretation of the different geophysical survey results and petrophysical measurements.

Data treatment for a hydrothermal reservoir assessment

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The main components of a hydrothermal system are the availability of a fluid to carry the heat, a conducting or heat producing basement, a reservoir to accommodate the fluid and specific reservoir parameters, e.g., thickness, lateral extension, porosity, permeability and thermal conductivity. Essential fluid parameters for a hydrothermal reservoir assessment are temperature, chemistry and quantity. The properties of a feasible geothermal object are partly measurable, but the geothermal potential depending on its recoverable volume has to be derived from the interpretation and modeling of geological and geophysical data and in a further step by geothermal modeling and simulation. The geological data framework is almost entirely derived from the hydrocarbon exploration and production. For demonstrating the methods of the geological and geothermal exploration the Calcalpine basement of the Vienna Basin is chosen as an example.

The reservoir is represented by dolomitic complexes of the northern frontal parts of the Calcalpine nappe system. In the area of Vienna, the prevailing hydrothermal reservoir rocks are Norian Hauptdolomite and to a minor degree Upper Carnian dolomites of the Lunz-Frankenfels-nappe. The structural features of the dolomite complexes are fold structures, forming two large anticlines (Höllenstein- and Teufelstein-anticline) and a syncline (Flössel syncline), detected by drilling in the areas of Kaisermühlen, Kagran and Hirschstetten, and geometrically analysed (Brix & Schultz 1993). The delineation of the reservoir in a 3D-model showing the structural features, the stratigraphic succession and the complex fold and fault system (Wessely 2006) is performed by application of the geological modeling software Petrel, developed by Schlumberger Co. The given geological sections and maps are imported as images and as grid files. Interpretation is performed directly on the geological profiles. For surface generation also information from wells is regarded. The generated surfaces are used as input for the modeling process. The model consists of regular, rectangular cells with a grid size of 100x100x50 m. Each of these cells is filled with reservoir parameters to obtain a 3D property model (Eichkitz et al. 2009). This property model is the input for the reservoir simulation.

Lithological, facial and petrophysical analyses are carried out using core samples and log analyses. For determination of the essential thermal properties, measurement of porosity, density, thermal capacity and thermal conductivity takes place under several different conditions (in a dry state and under saturation by high saline water). Regarding the dolomitic reservoir rocks different thermal properties have to be taken into account according to facial and diagenetic variations, whereas correlation between diagenetic processes, depositional environments and thermal properties can be created. Intercalations of claystone and the presence of evaporite have to be considered. From the analyses of the disposition of the permeable and impermeable zones the drainage system and fluid path are identified (Wessely 1983). Based on preceding information about temperature, pressure and salinity of the reservoir fluid gained by formation tests in the wells Kaisermühlen and Hirschstetten, the hydrothermal reservoir assessment shows the suitability of this area for exploiting heat respectively balneologic utilisation by means of the fluids of the Calcalpine basement.

The verification of the possibilities for the exploitation of hydrothermal energy depends on implication of an extensive database, which supplies the preconditions for energy- and economic calculation to assess the method of energy extraction and the estimation of the energy gain. The advanced methods to treat existent data of petroleum exploration for hydrothermal purposes in combination with additional investigations might assure a better selection of hydrothermal objects.

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Nutzungsmöglichkeiten tiefer Geothermie in Österreich

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Die Intentionen zur Nutzung tiefer geothermaler Energie in Österreich gehen in Richtung hydrothermale Nutzung (Wärmeentnahme aus zutage geförderten Lagerstättenwässern mit anschließender Wiederverpressung), aber auch

in Richtung Wärmegewinnung aus aufgelassenen Bohrlöchern (ohne Wasserentnahme) und schließlich werden Hot-Dry-Rock Verfahren mit unkonventioneller Wärmegewinnung ins Auge gefasst.
In allen Fällen erfolgt eine Vorerkundung des thermischen regionalen Gradienten, der thermischen Gesteinseigenschaften (Wärmekapazität und -leitfähigkeit) und der Fluide. Nach der thermischen und geologischen Modellerstellung wird die technische und wirtschaftliche Bearbeitung der jeweiligen Projekte durchgeführt, sowie die Beurteilung, ob Heizung/Kühlung oder Verstromung vorgesehen ist, in ersterem Fall, ob Abnehmer im Umfeld existieren.
Für die hydrogeothermale Erschließung bilden die geologischen-lagerstättenkundlichen Parameter (Temperaturniveau bzw. Tiefe, Aquiferkubatur, Porosität, Permeabilität, Salinität, Druck, Schüttungsmengen, Reinjektionsmöglichkeit) die Grundlage. Eine ausreichende Tiefe und eine Mindestwasserförderung ist Voraussetzung. Bestehende geologisch - geophysikalische Erfassung der räumlichen Ausdehnung der Aquifere ermöglichen bei entsprechender Bohrdichte eine Selektion und Rangordnung von geeigneten Projektgebieten. Bevorzugte Objekte sind kalkalpine Aquifere, vor allem Dolomite im Untergrund des Wiener Beckens (in eingeschränktem Maße in den Kalkalpen außerhalb des Wiener Beckens), Autochthones Mesozoikum unter Molasse (insbesondere Malmkarbonate und Deltasedimente des Dogger, Sandsteine und Konglomerate der Molassezone und der Wiener und Steirischen Beckenfüllung, Paläozoikum des Steirischen Beckens. Letzteres sowie der Malm Oberösterreichs werden bereits erfolgreich wirtschaftlich genutzt.
Die Klastika in jungen Beckenbereichen, aber auch im autochthonen Mesozoikum des Vorlandes (Dogger, Oberkreide) haben hinsichtlich Verbreitung und Mächtigkeiten von Aquiferen zwei Regulative - die sedimentären Schüttungsverhältnisse und das Ausmaß der synsedimentären tektonischen Absenkung. Die Schüttungskörper sind im wesentlichen sandige oder konglomeratische Produkte von Flüssen, vor allem in Deltabereichen und von mariner Umarbeitung dieser terrigenen Sedimente. Die Porositäten sind intergranular und verringern sich mit zunehmender Tiefe infolge Kompaktion und Kornverzahnung.
In den karbonatischen Gesteinen beruht die Porosität und Permeabilität hauptsächlich auf Klüftung (Wettersteindolomit, Hauptdolomit, Karbonate des Paläozoikum) infolge tektonischer Beanspruchung oder auf zusätzliche Verkarstung (Malm unter Molassebedeckung).
Eine Nutzung von Wärme aus aufgelassenen Bohrlöchern ohne direkte Benützung von Lagerstättenwässern, sondern nur durch Zirkulation mit geeigneten Transportflüssigkeiten kann nur bei einem vorhandenen Abnehmerpotential erfolgen. Technische Voraussetzung ist hier eine möglichst große Tiefe einer zugänglichen, intakten, möglichst großdimensionierten Verrohrung. Hier eignen sich besonders tiefe und übertiefe, nichtfündige Bohrungen. Beispiel einer erfolgreichen „in situ“ - Wärmegewinnung besteht bereits im Wiener Becken.
Eine Einbeziehung aller Kohlenwasserstoffbohrungen, nicht nur der abgeteuften sondern auch der in Planung be-

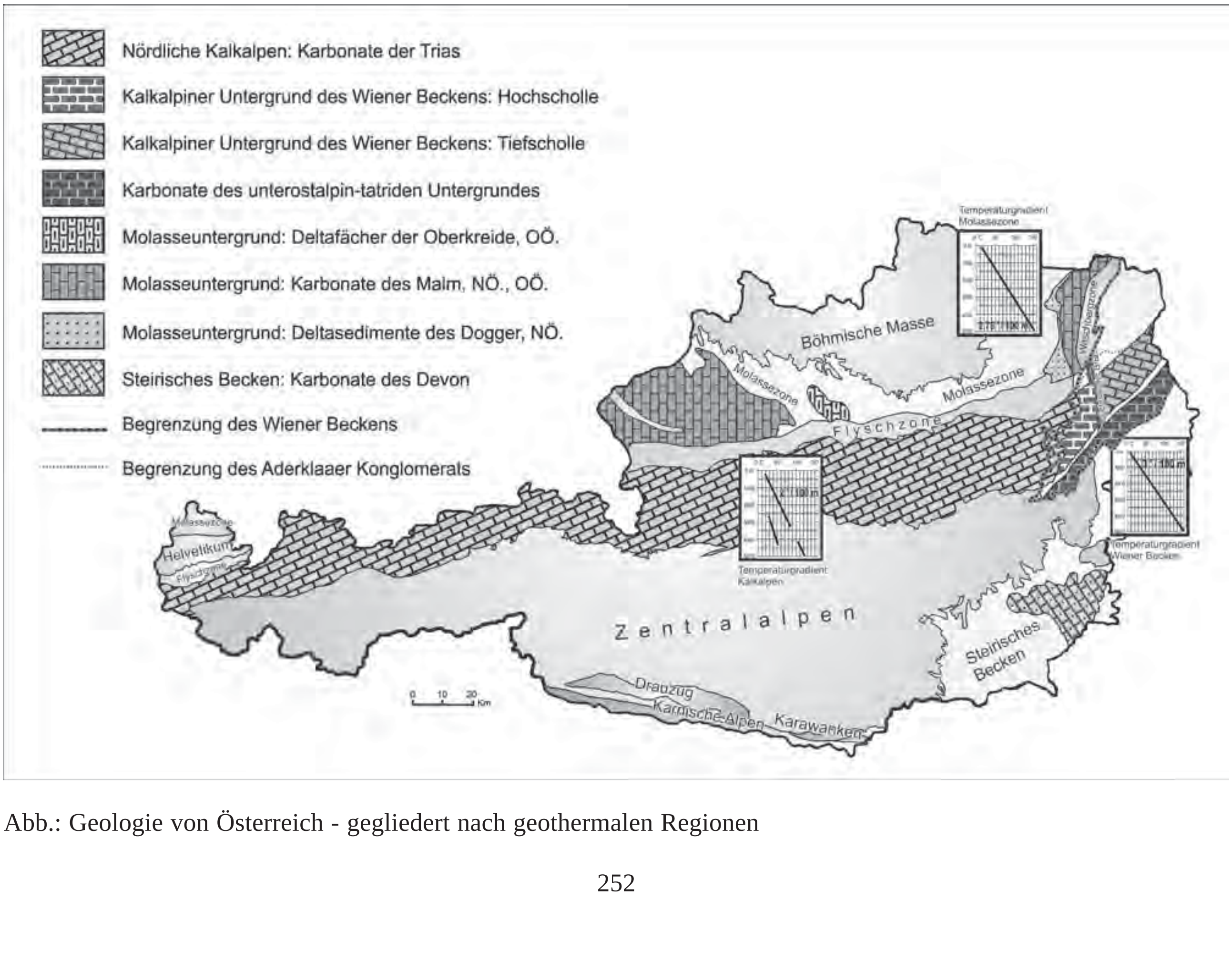

Abb.: Geologie von Österreich - gegliedert nach geothermalen Regionen findlichen, in ein Evaluierung hinsichtlich des geothermalen Potentials ist eine Herausforderung für die Zukunft.

Facies and lithostratigraphic anatomy of a Central Paratethys temperate carbonate platform (Leitha Mountains, Badenian, Austria)

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The Leitha Limestone is a widespread carbonate unit of Middle Miocene age in the Pannonian Basin System. Especially the Leitha Mts. represent a small isolated carbonate platform of Langhian to Early Serravallian age (=Badenian). This platform attains a size of c. 30 km length (NNE-SSW) and 6 km width. Seismic surveys document a potential thickness of more than 200 m for the entire carbonate succession, which consists pre-dominantly of corallinacean limestones. It comprises a variety of facies, characterized by different organism groups (e.g., corallinaceans, corals, molluscs, echinoderms and brachiopods) which reflect variable environmental conditions. Carbonate production itself is very sensitive to small environmental changes in basic parameters like climate, temperature, nutrients and water energy; especially in very shallow marine environments, marginal changes in water depth induce large displacements of facies zones. In the Central Paratethys Sea coral reefs s.s. seem to be limited to the Styrian Basin while for example in the Vienna Basin only coral carpets occur. Nevertheless, coral-bearing limestones are widespread along basin margins and platforms during the Mid-Miocene Climate Optimum (MMCO) extending northwards into the Carpathain Foredeep. With the onset of the Miocene Climate Transition (MCT), the paleogeographic extension of these bioconstructions became strongly limited and their northernmost occurrences remained in the area of the Pannonian Basin complex. Aside from the cooling, coral growth might have been negatively affected during the MCT by increased terrigenous discharge from the Alps due to more humid conditions. Coeval coral bioconstructions were therefore represented only by coral carpets and small patch reefs, restricted to isolated platforms. In the Leitha Mts. the interval from the MMCO to the MCT can be studied based on new nannoplankton data. These new findings allow a re-evaluation of the mollusc-, echinoid- and coral assemblages as well as the overall carbonate facies in terms of regional environmental shifts and global climate change.

Lithostratigraphy and facies of a Middle Badenian limestone succession in the Mannersdorf quarries (Austria, Central Paratethys)

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The Middle Miocene Vienna Basin is characterized by the development of small carbonate platforms along the basin margins and on tectonic highs. These comprise corallinacean limestones with rare and local coral patches or carpets. The successions within the platforms are expected to provide insight into paleoenvironmental and climatic changes, because they were more sensitive to regional factors like increased sediment or freshwater influx than open marine areas. In this study we want to characterize the north-eastern part of the Leitha Mountains carbonate platform with c. 80-m-thick continuous corallinacean limestone successions covering a Central Alpine Permian-Mesozoic core. The studied outcrops are close to the village Mannersdorf in Lower Austria. The faunal elements (e.g., *Porites*, *Tarbellastraea*, *Isognomon* and *Pholadomya*) indicate an Early/Middle Badenian (Early/Late Langhian) age for the limestones. The exposed sedimentary succession shows two transgressive-regressive (T-R) sequences and one transgressive phase. The first T-R sequence starts with basal conglomerates grading into poorly sorted gravel and coarse sand with a first intercalation of a corallinacean limestone bed. Upsection, this marine phase is terminated by progradation of fluvial gravel. The second T-R sequence starts with the development of marly corallinacean limestones, containing a shallow marine fauna including *in situ Pholadomya*. Upsection, deeper marine rhodolite carpets are developed which are replaced by marly limestones with *in situ Pinna* indicating seagrass facies. Seagrasses grow in the well illuminated intertidal and subtidal zone. In the present-day Mediterranean Sea, *Pinna* is found down to 10 m in association with seagrasses. The third transgression is represented by development of marl sand flats which in the recent are mostly found in water depth of about 40 m.

In-situ trace element and ID-TIMS Sm-Nd analysis of scheelite and Re-Os dating of molybdenite at Schellgaden, a Au-(W) deposit in the Eastern Alps, Austria

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