Final examination topics of the Geology MSc program

A) General questions

We expect that you are able to shortly (in 5 minutes) present your opinion and than continue a conversation on the listed topics. The aim of the „small" questions is to help you focusing and formulating your answer.

1) Field, laboratory, and instrumental analytical methods in geology

- You have an unknown rock, which is altered to clay minerals. Which methods would you use to be able to describe it properly? Describe the chosen methods briefly: how do they operate, why you have chosen them, what kind of information can be obtained?

- Micropaleontological examination is needed in a CH-potential area. Describe the steps and tools of a micropaleontological research from sample collecting to data analysis!

- What kind of observations and measurements comprise the base of geological maps? Explain the character and differences between pieces of information on the map which is directly related to field data and those derived during construction!

2) Isotopes in geology, geochronology

- How can isotope geochronology help to solve geological problems, give examples (you can also involve your MSc research topic)?

- What is absolute and relative geochronology? Tell examples and tools for relative geochronology!

- What are the most important methods to date geological samples using isotope systems? What are the limitations of using these methods?

- If you have a hydrothermally altered (to sericite and clay minerals) andesite, are you able to date the volcanism and/or the hydrothermal process? If yes, which method would you use?

Which isotopes are applicable in hydrogeological studies? What type of information can we get from these isotope data and what type of problems can be solved based on the different isotopes?

3) Shallow-water carbonate sedimentary rocks, their deposition and diagenesis:
Use the Dachstein Limestone (you have mapped in the field schoool) as an example!

- Describe the rock: minerals, microfacies, micro- and macrofossils. Varieties of its facies?
- In what kind of depositional environment was it formed? What are the most significant factors determining formation of the shallow-water carbonates (light, biota, salinity, climate, sea-level, orbital forcing etc)?
- What is the economic, practical significance of this limestone or any other shallow-water limestones of reef origin? How does the practical use of these limestones is influenced by their diagenesis?
- Normal faults are common in this limestone. What sort of stress field, large-scale structural geological processes are indicated by them? How do the faults influence the property of the limestones? How does groundwater move in fractured carbonates?
- What kind of fossils would you collect from shallow-marine carbonate rocks for biostratigaphical purposes? Name some typical groups as Paleozoic or Mesozoic index fossils!
- Which fossil groups are best suited for the biostratigraphy of this unit and similar shallow marine carbonates? What other stratigraphic methods are applicable for their subdivision, correlation, and dating?

4) Pelagic carbonate sedimentary rocks, their deposition and diagenesis:
Use the ammonitico rosso (you have mapped in the field schoool) as an example

- Describe the rock: minerals, microfacies, micro- and macrofossils.
- In what kind of depositional environment was it formed? What factors determine formation of the pelagic carbonates (nutrients, paleobiology, chemistry, circulation of the oceans, etc).?
- What are the styloliths? How do sytlolithic surfaces form? What kind of minerals accummulate along those surfaces and how does it influence permeability of the limestone?
- Name some fossil groups typical in pelagic sediments! What information might these fossils hold?
- Which fossil groups are best suited for the biostratigraphy of pelagic carbonates? What other stratigraphic methods are applicable for its subdivision, correlation, and dating?
- Describe the hydrogeological relevance of pelagic carbonates!

5) Siliciclastic sedimentary rocks, their deposition and diagenesis.

- Describe the mudrocks: minerals, grain size, primary sedimentary structures, their diagenesis.
- What type of river systems can be recognized in the rock record? Based on their facies models list the most important features, which help to distinguish them? Think about the channel forms, bars, size and extention of sand bodies.

- These sand bodies are encased in muddy floodplain deposits. Still some types can be important in groundwater flow, why? Illustrate with an example.
- Any other economic importance of fluvial systems?
- What kind of fossils would you expect to find on their floodplains? Which of these would be useful for biostratical purposes?
- Which fossils and what methods would you use to detect the paleoenvironment?
- Which fossil groups are best suited for the biostratigraphy of mudrocks? What other stratigraphic methods are applicable for its subdivision, correlation, and dating?
- Alluvial deposits are very common in half-grabens. When and how these basins form? Characterize the related structural elements!
- What is the hydrogeologic character of the mudrocks? How do the porosity and permebility changes with depth in case of shales?

6) Siliciclastic sedimentary rocks, their deposition and diagenesis.

- Describe the sandstones: composition of particles, grain size, sorting, porosity, permeability, their diagenesis.
- Explain the formation of primary sedimentary structures of sand! What is the practical use of these structures?
- Compare the facies model of deltas and that of the the wave dominate shoreface. Which characters are similar, which are diagnostic for one of them?
- What could be their economic importance? From traditional to the energy transition?
- What kind of fossils would you expect to find in sandstones deposited either in aquatic or eolic environments?
- Which fossil groups are best suited for the biostratigraphy of sandstones? What other stratigraphic methods are applicable for its subdivision, correlation, and dating?
- Characterize the deformation in strike-slip zones. Tell some recent examples!
- Describe the role of sandstone in the groundwater flow! Which are the permeability, porosity and hydraulic conductivity conditions of the sands and sandstones?

7) Siliciclastic sedimentary rocks, their deposition and diagenesis.

- Describe the conglomerates: composition of particles, grain size, fabric, their diagenesis.
- What type of sediment gravity flows are commonly recognized in the rock record? Compare and characterize the facies of two different conglomerate types. Describe the varieties of sandy turbidites.
- Place the above rock types into the facies model of a turbidite system. Based on the sand/mud ratio, explain which architectural elements of the system can be good/poor HC reservoirs.
- What kind of fossils are related to turbidite successions?
- Turbidite systems are common in the foredeeps of orogenic belts. Why? What kind of deformation, structural elements are active in orogens. Tell some recent examples

8) Geological aspects of the current global environmental change

- What proxies can be used to identify/follow climate changes?
- Which instrumental analytical methods can be used to reconstruct the paleoclimate (temperature, precipitation) of a region?
- Which geochronological methods can be involved in paleoclimatological studies?
- Explain the use and role of fossils in paleoecological reconstructions!
- How does the climate change affect groundwater flow systems?
- How can we mitigate the effect of hydrological extremes? What type of methods do you know?

9) Fluids in the lithosphere

- Which type of fluids are found in the lithosphere? Describe their origin, chemical composition, and evolution!

- What are the transport mechanisms of these fluids in the unsaturated and saturated zone?

- How do these fluids contribute to different subsurface and surface geological processes?

- What type of fluid driving forces existing in sedimentary basins? What is their relative significance?

- Choose an example and introduce the significance of fluid (groundwater, gas etc) in the given process! (e.g. heat transport, land subsidence, landslides, saltwater intrusion, hydrothermal ore formation, petroleum migration and trapping, diagenesis etc).