OUGSME Post-Exam Field Trip to the Oberpfalz and West Bohemia.

If you wish to locate the geographical region where we will spend most of the week, find a decent map of Central Europe and locate Munich. The city of Regensburg lies about 125 km NNE of Munich. Regensburg is the provincial capital of the Upper Palatinate or Oberpfalz. The Oberpfalz is approximately trapeze-shaped and consists of the region northwards from Regensburg to the town of Marktredwitz, eastwards up to the border with the Czech Republic and westwards to the town of Neumarkt i.d. Opf. Windischeschenbach and the KTB are about 70 km north of Regensburg and Münchberg is about 15 km south of Hof. Marienbad, or Mariánské Lázně, and Teplá are located in western Bohemia some 45 km and 55 km, respectively, east of the town of Marktredwitz.

When I originally started planning this trip, I concentrated solely on the aspect of the Cadomian and Variscan basement rocks in the Oberpfalz and West Bohemia. During a visit to discuss the trip with our chief guide, Dr. Andreas Peterek, I was well and truly made aware of the significance of the neotectonic activities in this region and they will now play an equally important part of the programme as the basement rocks. To quote Dr. Peterek, 'The Eger Rift Valley is one of the most striking neotectonic structures in Central Europe'.

The reconstruction of past continents and their configurations seems to work fairly well, back to about 750 Ma, the Cryogenian, when the collision of East Gondwana, Laurentia and Amazonia resulted in the formation of the supercontinent Rodinia, just north of the South Pole. This reconstruction is based mainly on palaeomagnetic data and the location of Grenvillian orogens. When the movement and assembly of microcontinents are involved, things become more speculative.

It is generally proposed that Avalonia* rifted from Gondwana sometime between the Late Cambrian and Early Ordovician, ca. 490 Ma ago and subsequently drifted towards and collided with Laurentia, during the Caledonian collision, ca 440 Ma, to form the basement rocks of much of England, Wales and southern Ireland. It is often assumed that Armorica*, consisting of a number of terranes, also rifted from Gondwana by the Early Ordovician (488 Ma-478 Ma) and collided with Laurussia by the Late Devonian (ca. 375 Ma), as the Rheic Ocean closed.

Recent publications now assume that this rifting of Armorica from Gondwana never occurred and that Armorica was still part of northern Gondwana when Pangea formed as a result of the Variscan collisions. As Pangea split up during the Late Jurassic to Late Cretaceous (ca.150 Ma-85 Ma), Armorica finally rifted from what is now Africa, to form the basement rocks of the much of central Europe.

So where does the Cadomian orogeny fit in to all this? There is a lot of confusion when the terms Cadomia or Cadomian are used, as to what is actually meant. The Cadmonian orogeny is defined by McCann, T. (ed) 2008 . *The Geology of Central Europe. Volume 1: Precambrian and Paleozoic.* Geological Society London, as:

'A series of complex sedimentary, magmatic and tecto-metamorphic events that commenced during the mid-Neopoterozoic (ca. 750 Ma) and extended into the earliest Cambrian (ca. 540-530 Ma). These events occurred along the periphery of the supercontinent of Gondwana and were the last of a series of events which formed the crystalline basement rocks of Europe'.

Assuming Armorica was still part of Gondwana as Pangea was formed by the collision of Laurussia and Gondwana during the Variscan Orogeny, (Late Devonian to the mid-Carboniferous), three distinct tectonic structual units or zones were formed, in what today is

represented by Central Europe. These structural units or zones are defined in the following website:

http://science.jrank.org/pages/48241/Variscan-orogeny.html
Variscan orogeny - Fig. 1., verge, Tectonophysics, Geological Society of America Special Paper. The evolving continents.

1) A northern Rheno-Hercynian* zone, of low metamorphic grade, with mainly Devonian sediments and a few Permian granites. It is bounded to the north by north-verging thrusts that override Stephanian coal-bearing foreland basins.
2) The central Saxo-Thuringian* zone which was a source of the Late Devonian to Early Carboniferous flysch of the Rheno-Hercynian zone. A high-grade gneissic core is thrust northwards over lower-grade lower Palaeozoic sediments. Granites are common.
3) The southern Moldanubian* zone represents the internal zone of the orogen comprising high-grade metamorphic rocks, commonly Precambrian, and abundant (80per cent) Late Devonian to Late Carboniferous granites and migmatites. However, low-grade Lower Palaeozoic sediments occur locally. In the south of this zone structures *verge* southward; that is, the folds are inclined or overturned in a southerly direction. Further south, basement inliers or windows within the Alpine nappes and the Pyrenees, contain Cambrian to Devonian sediments affected by pre-Stephanian metamorphism with syn- and post-tectonic granites.

An important feature of all the Variscan zones is that they have a basement which is typical of Gondwana and were deformed during the Pan-African Cadomian orogeny (600–550 Ma). The Saxo-Thuringian and Moldanubian zones also contain Ordovician faunas and glacial deposits typical of Gondwana.

If you have access to *The Geology of Central Europe,* edited by T. McCann and published by the Geological Society, London, you can find much of the current information available about the geology of Central Europe, although the entry regarding the Eger Rift Valley is very modest. However, you need to be prepared to search through this massive work, containing a total of about 1,500 pages, to find the information relevant to the area and the era that you are interested in. I found Chapter 1 'The introduction and overview', Chapter 2 'Precambrian' and in particular, Chapter 11 'Variscan tectonics' to be very infomative.

A good alternative to the *The Geology of Central Europe* is the paper:

'Tectonic and Plate Tectonic Units at the North Gondwana Margin: Evidence from the Central European Variscides'

by Wolfgang Franke (Intsitut fuer Geowissenschaften, Justus-Libieg Universitaet, Giessen.) 1999 and published by the 'Austrian Geologischer Bundesanstalt' in Vienna. (The Bundesanstalt kindly permit the reproduction of their publications for educational purposes, for which we wish to express our gratitude.) This publication is much shorter than the information contained in *The Geology of Central Europe*, but it covers the main effects of the Variscan Orogeny on the geology of Central Europe and it supplies a geological map and an informative sketch or plate kinematic cartoon of the Central European Variscides, from the Late Silurian to the Late Devonian, (ca. 420 Ma-360 Ma). These are the events which were responsible for the formation of the three structural tectonic units described above. These

units are shown assembled by the Frasnian, in the cartoon on page 12, they are from left to right, or approximately north to south, the Rheno-Hercynian, the Saxo-Thuringian and the Moldanubian zones. The paper can be found on the website of the 'Austrian Geologischer Bundesanstalt' under:

www.geologie.ac.at/filestore/download/AB0054_007_A.pdf

I advise you to print pages 10, 11 and 12, and refer to these while you are reading the main body of the text. The geological map on pages 10 and 11 also shows the position of the KTB, the Münchberg Complex, the Fichtel Mountains, the Teplá-Barrandium unit and the Eger Graben. (Note, this document starts with page 7! The pages numbered 10, 11 and 12 are the fourth, fith and sixth pages within the document.)

The assembly of the Bohemian Massif together with the Saxo-Thuringian and Moldanubian zones during the Variscan orogeny, left the Bohemian Massif surrounded by major faults on all sides. On the western flank, it is bounded by the Franconian lineament, a NW trending system of deep reverse faults of late- to post-Variscan origin, which were reactivated by the Alpine Orogeny. The continuation of the Frankonian lineament through the Moldanubian zone comprises mainly of the Bavarian Pfahl and Donaurandbruch faults.

The northern boundary of the Bohemian Massif is formed by the Eger or Ohře Rift Valley, which is approximately 300 km long and 50 km wide. The rift system is part of the European Cenozoic Rift System, together with the Rhine and Auvergne Grabens. The Eger Rift evolved at the Upper Cretaceous/Tertiary boundary and reactivated the Variscan Saxo-Thuringian/Moldanubian suture zone. The main rifting phase took place between 42-9 Ma, with the graben formation and intraplate alkaline volcanism. The rifting process is still active today, this results in CO_2 emission at the surface in NW-Bohemia, the source of the moffetes fields, and continued uplift in some southern parts of the rift, accompanied by earthquake swarms.

McCann *et al* describe the Bohemian Massif as being the most important inlier of Cadomian and Variscan basement rocks in Central Europe. The northern part of the massif forms a section of the Saxo-Thuringian Zone and its southern part lies in the Moldanubian Zone, which also contains the Teplá-Barrandium unit. During our trip, we will be visiting sites and outcrops in both the Saxo-Thuringian and Moldanubian western border zones of the Bohemian Massif, as well as in the Eger Graben and in the Teplá-Barrandium unit. For more information regarding the field-trip, please see the excursion abstacts, which are attached to the trip programme.

* Wikipedia offers the following explanations for the marked names:

Cadomia: The name comes from *Cadomus*, the Latin name for Caen, northern France.

Variscan: The name, *Variscan*, comes from the Medieval Latin name for the district *Variscia*, the home of a Germanic tribe, the Varisci, which is approximately the region of the Vogtland. Today, Vogtland is mainly in state of Saxony but spreads also into Bavaria, Thuringia and Bohemia. The Latin name of the town of Hof is 'Curia Variscorum'.

Avalonia: Named after the Avalon Peninsula in Newfoundland.

Armorica: Its name comes from the old Armorica, which was a Gaul area between

the Loire and the Seine rivers.

Rheno-Hercynian:	A narrow zone extending from the Rhenish Massif (Ardennes, Eifel,Taunus and Hunsrueck.) to the Harz Mountains.
Saxo-Thuringian:	The Saxo-Thuringian Zone or Saxo-Thuringicum is a structural or tectonic zone in the Hercynian or Variscan orogen of central and western Europe.
Moldanubian:	Named after the Moldau and Danube rivers, the Moldanubian is a tectonic zone formed during the Variscan or Hercynian Orogeny. The Moldanubian Zone crops out in the Bohemian Massif and the southern part of the Black Forest and Vosges and contains the highest grade metamorphic rocks of Variscan age in Europe.