The results have been promising in the stratigraphically complex Munderfing gas field and in the Oligocene Friedburg gas field. Less successful have been attempts to use this method where well control is sparse. The Miocene Upper Puchkirchen A1 and A2 series were analyzed in the Puchkirchen area. The complex lithology that overlies the unconformity at the top obscures the reservoir distribution maps. The results from the geostatistics in the Puchkirchen area are not yet tested.
In general, the resulting maps show patterns that have to be compared with the general sedimentoligical model. They can lead to modification and refinement of the existing models, and tell us something about the specific processes and basin geometry at the time of deposition. The maps and it's subtle patterns also form a validation criterion for the still experimental method of (geo)statistics within RAG.

Middle Permian fan-delta complex of the Gorski Kotar (Croatia)

ALJINOVIC, D.

University of Zagreb, Faculty of Mining, Geology and Petroleum Engineering, Zagreb10 000, Pierottijeva ul. 6, daljin@rudar.rgn.hr

Intensive uplift occurred at the end of Lower or at the beginning of Middle Permian resulted in molasse type sedimentation and the of vast quantities of siliciclastic sediments were accumulated in the Gorski Kotar area (central part of Republic Croatia). The presence of autochthonous marine fossils (ammonoids, brachiopods, crinoids), found in black shales that intercalate with conglomerates and sandstones, allow the assumption of fan delta type sedimentation.
The successions described in the northern part (successions in the vicinity of Tršce) and in central part of Gorski Kotar (vicinity of Mrzla Vodica) envisioned the two different fan delta type sedimentation which reflect the different depth of the sedimentary basin. Deeper and shallower part of the delta assume the different basin floor morphology and possibly resulted as a consequence of a different subsiding processes due to subbasinal faulting in a tectonically active area.
The sedimentation processes in central part of Gorski Kotar were determined by steep delta slope. Sliding as well as formation of chutes have been noticed. The following fan delta facies were recognized: 1) delta-slope facies and 2) prodelta-shelf facies. The delta slope facies is characterized by several types of conglomerates and usually coarse grained sandstones that are: matrix supported massive conglomerates (Gms), clast supported massive conglomerates (Gmc), normally graded conglomerates (Gg), inversely to normally graded conglomerates ((in)g_2g_1G), gravelly mudstones (GyM), calcrudites (D) and massive sandstones (Sm). The prodelta-shelf facies is determined by: sandstone-shale intercalations (SM), shales (M) and planar bedded calclithites (C). In shale intercalations the autochtonuous ammonoid fauna has been found. Sedimentation processes record the slope-type delta of ETHRIDGE & WESCOTT (1984).
In northern part of Gorski Kotar the sedimentation was determined by low inclined relief with coarse clastic sedimentary rocks described as 1) mouth bar facies and 2) subareal or coastal facies. The mouth bar facies association consists of: normally graded conglomerates (Gg), inversely graded conglomerates ((in)gG), inversely to normally graded conglomerates ((in)g_2g_1G), massive matrix supported conglomerates (Gms), massive clast supported conglomerates (Gmc) planar cross bedded conglomerates (Gp), trough bedded conglomerates (Gt), gravelly sandstones, where gravels faintly mark shallow troughs, (GyS) and parallel laminated sandstones (lS). Subareal or coastal fan delta facies is characterized by irregularly bedded sandstones and gravelly sandstones (A) and micaceous sandstones (B) containing coarse plant detritus. Shales (M) and sandstone-shale intercalations (SM) are interpreted as prodelta-shelf facies. The delta type sedimentation corresponds to shelf-delta of ETHRIDGE & WESCOTT (1984).
Sandstone-shale intercalations, interpreted as prodelta-shelf facies, have similar characteristic in central and northern part of Gorski Kotar and were interpreted as unique "back-ground" sediment deposits connecting the two fan delta types. According to fossiliferous sediments associated with sandstone-shale intercalations (found only in the central part), the same age is proposed for the clastic fan delta sequence of the Gorski Kotar. Analyses of the fossil assemblage in calclithites (C), although considered as resedimented detritus, permit the conclusion of Middle Permian age (SREMAC & ALJINOVIC 1997).
Carbonate sedimentation, equivalent of Bellerophon formation, is missing in Gorski Kotar, thus assuming the hiatus between Permian and Lower Triassic sedimentary rocks. During Upper Permian the intensive inundation lowered the uplifted relief and the Lower Triassic sedimentation was characterised by shallow marine deposition on flat relief.

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Die ICE-Neubaustrecke Köln-Rhein/Main in Hessen: Ein geologisches Schaufenster

ANDERLE, H.-J. & RADTKE, G.

Hessisches Landesamt für Umwelt und Geologie, Leberberg 9, D-65193 Wiesbaden

Von der Deutschen Bahn AG wird zur Zeit die Neubaustrecke zwischen Köln und dem Rhein/Main-Gebiet (Frankfurt) gebaut. Der Geologische Landesdienst Hessen war bei den Voruntersuchungen beteiligt und dokumentiert z. Z. die Geologie während der Baumaßnahmen, wobei Einschnitte und Tunnelbauten zusammenhängende Aufschlüsse bieten. Der hessische Teil der ICE-Trasse ist ca. 65 km lang und quert das südliche Rheinische Schiefergebirge und den Nordrand des Oberrheingrabens bis zur Mainebene. Dabei durchläuft sie von N nach S folgende geologische Großeinheiten: Moselmulde, Lahnmulde mit Limburger Becken, Hintertaunus mit Idsteiner Senke, Taunuskamm, Vordertaunus, Hofheimer Rotliegend-Scholle, Mainzer Becken und Nördlichen Oberrheingraben. Die ältesten Gesteine findet man im Vordertaunus mit ordovizisch-silurischen Metavulkaniten/ Metasedimenten und nach N jünger werdend im Hintertaunus mit unterdevonischen Schiefern und Sandsteinen und in der Lahnmulde zusätzlich mit Kalksteinen und Metavulkaniklastika ("Schalstein"). Nach S zu folgen Rotliegend-Fanglomerate sowie tertiäre und quartäre Sedimente wie Ton, Mergel, Kalksteine und Schluff, Sand, Kies. Da sich der Verlauf der Trasse an geologisch jungen Senken orientiert, sind häufig quartäre Deckschichten über tiefgründig verwitterten Gesteinen (Saprolith) angeschnitten. Die geologischen Großeinheiten werden von großen Störungssystemen getrennt, wie z. B. die Taunus-Südrand-Störung oder die Westrand-Störung des Oberrheingrabens. Sie begrenzen auch die verschieden gebauten tektonischen Einheiten des Taunus mit kompliziertem Schuppenbau im Vordertaunus und Taunuskamm sowie einfacherem Schuppen- und Faltenbau in Hintertaunus und Lahnmulde.
Eine Fülle neuer Beobachtungen konnte gemacht werden: Es gelang der Nachweis von Mittel- und Oberdevon im Vordertaunus sowie von Pechelbronn-Schichten (O-Eozän/U-Oligozän) im nördlichen Oberrheingraben und der nach Norden übergreifenden Mitteloligozän-Transgression (Rupelton - Cyrenenmergel) auf den

Taunus.
Das südlich an den Taunus anschließende Rotliegend war in der Tunneltrasse als Fanglomerat aus Taunusmaterial aufgeschlossen. Drei Kilometer weiter südlich wurde es erst in 145 m Teufe in feinkörniger Fazies erbohrt.
Im Taunus zeigt sich ein noch intensiverer Schuppenbau als bisher angenommen. Im Einzelfall konnten Teilschuppen, Überschiebungsbahnen, Mylonite und Brekzien dokumentiert werden. Im Bereich wechselnd kompetenter Gesteine des Taunuskammes ist eine hohe Zahl von Schuppen entwickelt. Erstmalig waren im Vordertaunus zahlreiche nach SE gerichtete spätvaristische Rücküberschiebungen zu beobachten. Außerdem tritt dort abweichendes N-S- bis NW-SE-Streichen auf. Die Taunus-Südrand-Störung ist durch eine saigere rechtshändige Seitenverschiebung versetzt. Häufig sind postvaristische Dehnungsgefüge im varistischen Gebirge, die z. T. mineralisiert sind (u. a. mit Quarz, Calcit, Dickit, Pyrit).
Die varistisch konsolidierten Gesteine des Taunus sind nur selten Festgesteine. Denn spät- und postvarstisch sind sie durch Tektogenese, hydrothermale Aktivität und Verwitterung unterschiedlich entfestigt worden.
Diese Ergebnisse haben gezeigt, dass selbst nach 150 Jahren Geologischer Landesaufnahme in schlecht aufgeschlossenen Gebieten noch wesentliche neue Erkenntnisse über den Untergrund zu gewinnen sind.

Criteria for Recognizing an Orbitally Forced Cyclic Hierarchy: The 'Purbeckian' at the Classic Sierra del Pozo Section (Berriasian) Southern Spain

ANDERSON, E.J.

Geology Department, Temple University, Philadelphia, PA 19122, andy@astro.temple.edu

The Lower Cretaceous Sierra del Pozo Formation is totally divisible into meter-scale cycles that can be bundled in a three-tiered hierarchy (fig. 1). The smallest scale cycles (6th order), thought to be the product of precessionally forced sea-level change average less than a meter in thickness, shallow upward and are bounded by surfaces where deeper facies abruptly overlie shallower facies. These 6th order cycles may be grouped into sets (5th order sequences) of 2 to 6 cycles by periodic change (100 ka) in the eccentricity of the Earth's orbit. These larger-scale, 5th order sequences, are recognized by an asymmetric pattern in the degree of facies change internal to successive, constituent meter-scale cycles. Near the base of a 5th order set (i.e. in the first or second 6th order cycle) the magnitude of facies change at the basal cycle boundary is greater than that in subsequent cycles in the set. The next larger tier in the hierarchy (4th order) comprises sets of four 5th order sequences. This tier is the product of a longer term variation (400 ka) in eccentricity. Typically a maximum degree of eccentricity (and a resulting maximum degree of facies change) is observed near the base of the second 5th order sequence of the 4th order bundle. That is high eccentricity causes the strongest precessional signals in the second 5th order sequence in a 4th order set.
Jimenez de CISNEROS & VERA (1993) described 141 cycles in a 280 m interval in the Sierra del Pozo section. Their cycle boundaries are defined at surfaces where suhtidal-facies abruptly overly tidal-flat facies, where there is evidence of exposure (i.e. karst or soil) or at marked discontinuities. Cycle thicknesses on their log (varying between 1-4 m) are precise and and reproducible. They conclude that the average duration of the cycles they describe is approximately 40 ka and that this time interval suggests that obliquity-forced sea-level change is the most probable explanation of the origin of the cycles.
Re-evaluation of the cyclicity in this section applying a 'Milankovitch' based hierarchic genetic model (ANDERSON & GOODWIN 1990, GOODWIN & ANDERSON 1997) indicates that the thicker cycles described by Jimenez de Cisneros and Vera are composite cycles and that meter-scale cycles (some of which are recognized by CISNEROS & VERA 1993) are bundled in a 3 tiered hierarchy. This hierarchy conforms well with the tiered cyclic struc-ture described by STRASSER & HILGARTNER (1998) in rocks of the same age (and similar facies) in the French Jura. The 3-tiered stacking patterns and time limitations observed in both areas support a 'Milankovitch' forcing mechanism.

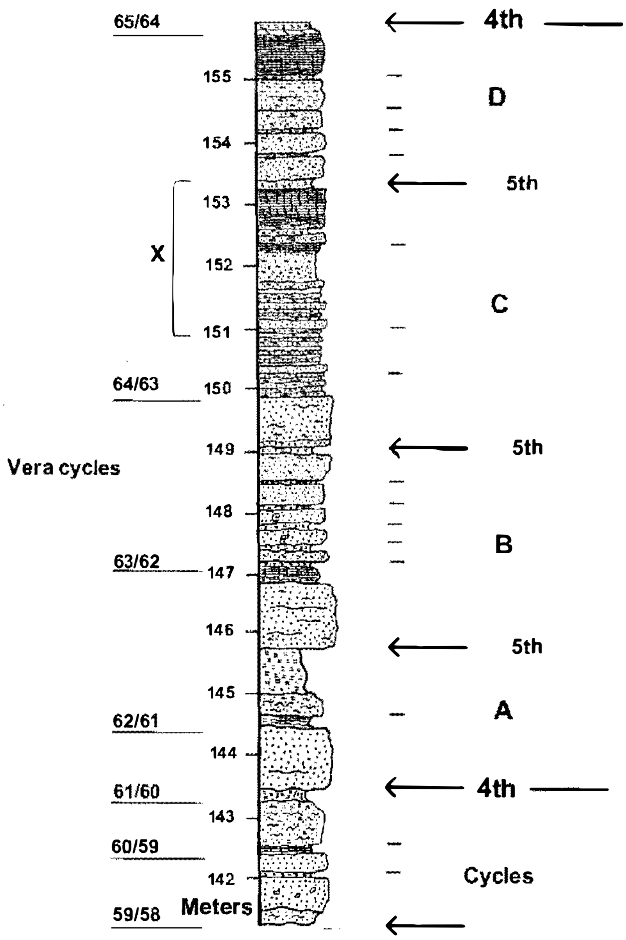

Fig. 1: Stratigraphic log of part of the Sierra del Pozo Formation. Cyclic hierarchy on right and Vera cycles on left. Dashes show 6th order cycles.

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