REVISITING KILMICHAEL (MISSISSIPPI), A POSSIBLE IMPACT STRUCTURE. M.S. Huber[1] and D.T. King, Jr.[2], L.W. Petruny[2], and C. Koeberl[1,3] Department of Lithospheric Research, University of Vienna, Althanstrasse 14, 1090, Vienna, Austria, matthew.huber@univie.ac.at, [2]Geology Office, Auburn University, Auburn, AL 36849 USA [kingdat@auburn.edu], [3]Natural History Museum, Burgring 7, A-1010 Vienna, Austria.

Introduction: The Kilmichael structure (~9.6 km in diameter), located near Kilmichael, Montogmery County, Mississippi, has long been recognized as an unusual structural feature [1]. The feature has been interpreted in two main ways. Some researchers favor an impact interpretation [2, 3], while others favor a simple structural uplift [4]. There is minimal surface expression of the structure, and the highly vegetated nature of the site obscures what outcrops are available. In this study, we have re-examined two drill cores from the Kilmichael structural area in order to better constrain the possible interpretations of the structure. Herein, we present evidence for an unusual stratigraphic succession near the center of the structure and suggest that this succession may be more consistent with an impact interpretation. In the near future, we will study core samples to seek a more definitive answer to the question of origin.

Previous interpretations: The structure was first examined in 1943 by Richard Priddy [1], who catalogued a series of faults defining the edges of the Kilmichael structural area. The first interpretation of possible impact was made by Mark Butler in 1962 [2]. Later, an investigation by Steven Ingram of the Mississippi Office of Geology (MOG) concluded that the structure was the result of structural "pulsed growth" [4]. In 2000, a preliminary petrographic investigation of samples "taken at about 3 to 10 m spacing" in core #2 resulted in no petrographic evidence being found for impact [6].

Drill Cores: Two drill cores were investigated in this study; both of these cores were drilled by the MOG. MOG Kilmichael #2 is located at 33º 29.41' N, 89º 33.05' W and the drilling site was situated 104 m above sea level. MOG #2 is near the center of the proposed impact structure. Core was recovered to a depth of 143.3 m. MOG Kilmichael #3 was drilled at 33º 31.63' N, 89º 33.60' W, and the drilling site was situated 127 m above sea level. Core was recovered to a depth of 106.7 m in the hole. The two core holes are separated by 4.25 km. Stratigraphic columns for both of these cores are shown in Figures 1 and 2, respectively.

Results: Core MOG #2 has weathered sediments spanning the upper 9.1 m, then after 0.6 m of clay, there are 6 m of very fine grained quartz sands mixed with clay and gravel. This overlies a glauconitic sand at 17.3 m, which caps a 59.5 m thick sequence of sandy gravel. The unit is quartz-rich sandstone containing mainly chert gravel up to 4 cm in diameter. The gravel is rounded, however, some clasts are broken. There are uncommon lignite, clay, and chalk clasts of smaller size. The sandy matrix is angular, very fine grained, and includes some feldspar grains and some black grains in the same size range. Below the 59.5-m thick sand and gravel layer is a thick enigmatic breccia. The breccia has a clay and sand matrix (usually a grey color). There are clasts of white sand, clay, lignite, and chert. The largest observed individual clasts are 8 cm in length, although there are also some apparent large blocks within the core, e.g., a peripherally deformed clay block from the Porter's Creek Formation spans 85.7 to 87.1 m and a deformed block of white chalk (Prairie Bluff Chalk) is present from 92.1 to 95.5 m depth. This breccia has a sharp contact both above and below with the associated rock blocks. This breccia grades into a poorly consolidated clast-rich sand at 100.6 m depth. At 122.5 m, the sand has a sharp contact with the same breccia observed above. Below 130 m, the clast population in the breccia decreases and the size of clasts decreases. At 142 m, the breccia contains mainly white sand clasts.

Core MOG #3, unlike #2, contains no matrix-supported breccias. The upper 7.3 m contain organic-rich surfacial weathered materials. Then, there is a glauconitic sand that grades downward into a fine-grained sand. Down to 21.3 m, there is an organic rich sand displaying sulfur on the core's surface. Also, there are numerous instances of oil residue seeping to the surface of the core. From 28 to 29 m, a poorly consolidated clast-rich sand is present. The predominant lithology from 42.3-51.9 m is gray fissile clay, probably of the Porter's Creek Formation, which is horizontally bedded. In places, this lithology transitions to laminated siltstone, which contains zones of black, organic-rich material, including lignite and clay with a high percent of total organic carbon. Between 51.9 and 67.1 m, there is a massive, tan-white sand interval in the midst of the Porter's Creek. At about 95 m, there is a ripple-bedded sandstone, which overlies poorly consolidated glauconitic sand. At 95.8 m, the lithology is a gray silty clay that is similarly organic rick as compared to the Porter's Creek deposits above.

Discussion: MOG #2 contains a thick section of sand and gravel (Gravel Creek Member of the Nanafalia Formation), which is missing from the other

core. Further, and perhaps more importantly, there is a substantial amount of enigmatic matrix-supported breccia in MOG #2. What we interpret as deformed blocks of Porter's Creek Formation, Prairie Bluff Chalk, and Ripley Formation (in that order), occur within what we interpret as one, thick matix-supported breccia unit. The MOG #2 core ends in this breccia unit. Descriptions of deeper well cuttings made by MOG geologists suggest that the breccia continues to the total drilled depth (234.7 m) and probably beyond that depth, and blocks of older chalks (Demopolis and Mooreville) may be present in the cuttings interval. The presence of large Upper Cretaceous rock blocks (Prairie Bluff and Ripley; possibly even Demopolis and Mooreville) indicates derivation of material from considerable depth in the subsurface section.

We have collected samples from both wells, and will be looking closely at them for traces of impact as a possible explanation of the unusual sequence found in MOG #2 versus MOG #3. Of particular interest to us will be the enigmatic breccia in MOG #2.

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References: [1] Priddy R.R. and McCutcheon T.E. (1943) Mississippi State Geological Survey Bulletin 51. [2] Butler M.D. (1962) *Miss. Acad. Sci. 8*, 51-52. [3] Robertson P.B. and Butler M.D. (1982) *Journal of Geology*, *90*, 589-601. [4] Ingram S.L. (1996) MOG Kilmichael #2 Core Hole Log. [5] King, Jr. D.T. and Petruny L.W. (2006) *Gulf Coast Association of Geological Society Transactions*, *56*, 341-351.[6] Koeberl C. et al. (2000) *LPS XXI*, Abstract #1602.

Notes on figures: Figure 1 - MOG Kilmichael core #2, as logged by us. At left, meter depths to contacts in lithic column. In central column – depths in feet (as per core box markings) and main lithic units. At right, our present interpretations of the main lithic units. Paleontological samples reviewed for MOG [4]: *1 = "Paleocene-Eocene" and *2 = "lower Maastrichtian to upper Campanian." Footnotes on formation ages: 1 = lower upper Paleocene (Selandian); 2 = Maastrichtian (CC24); 3 = Maastrichtian (CC25); 4 = Maastrichtian and Campanian chalks (Demopolis and older (?). Note – Cuttings from lower part of this core hole were not examined in this study. All main lithic units were sampled by us for futher study.

Figure 2 - MOG Kilmichael core # 3, as logged by us. Same organization as Figure 1. Note – All main lithic units were sampled by us for further study. There was no paleontological sampling of this core by MOG.

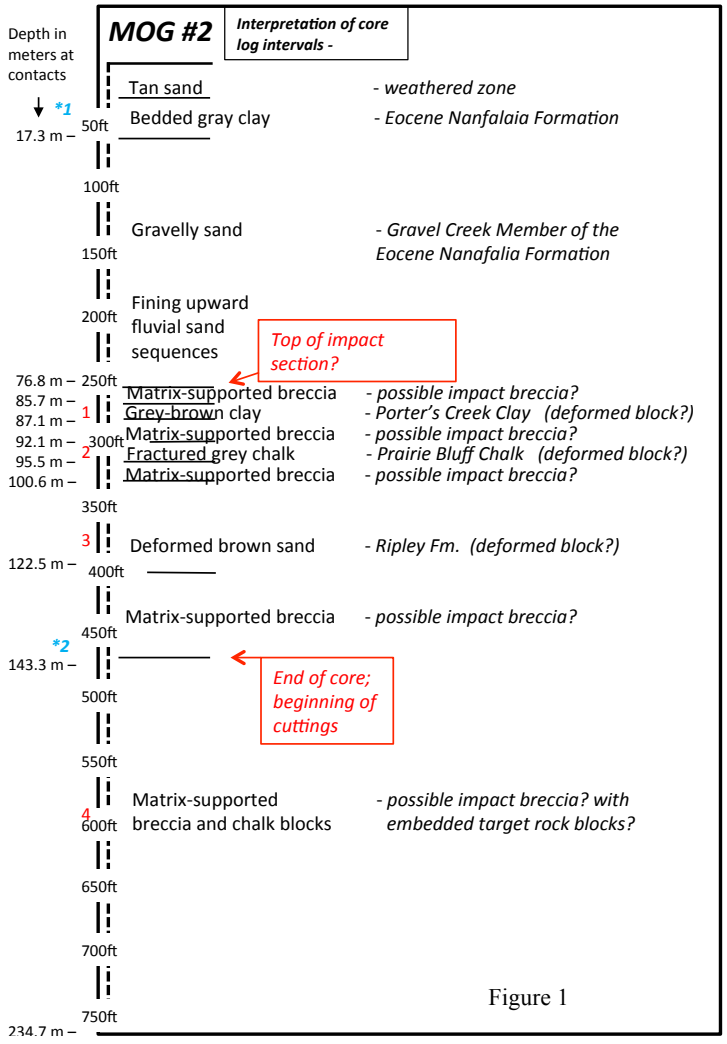

Figure 1

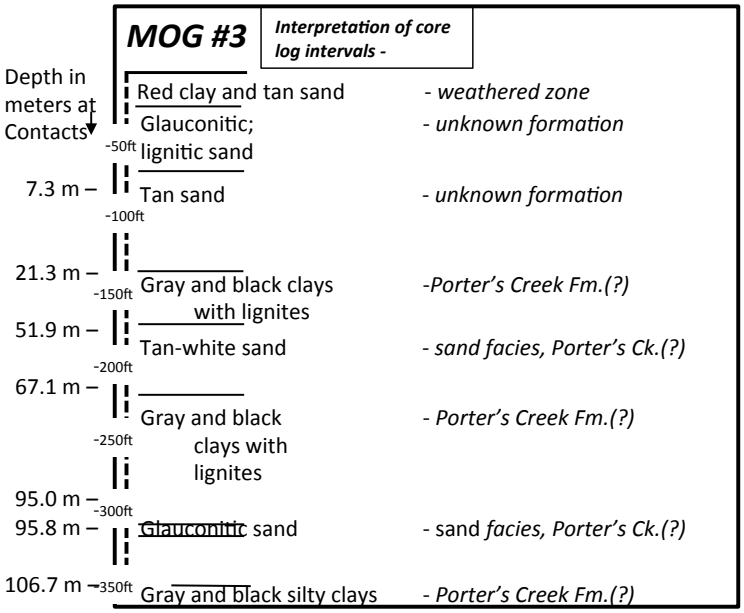

Figure 2