Russellville 100k SIM review copy

Notes for the reviewer

The Russellville 30’x60’ map consists of two parts, a SIGMa-GEMS compliant relational GIS database that will be distributed as a data release and a SIM map product, that will be distributed as a map layout, without a pamphlet. The map layout will have the Russellville 100k geologic map, a description of map units, a correlation of map units, references, 4 figures for more general context of the map, a stratigraphic column, a list of references, and several pictures.

This review document is an extra extraction of the tables from the projects’ GIS-based SIGMa – GEMS database for ease of review and will not be included as a pamphlet. Geologic province, descriptions, which are a flexible time-space framework for ordering and cataloguing map units, will not be displayed on the map layout, however they will be included in the GeologicProvinces table of the GIS database and form the main organizational structure within the database. The reason that they are included here is to easily highlight their hierarchy and relationship with the map units included in each province.

Hereby an excerpt from Turner and others, 2022, on how the SIGMa – Gems database relates to a GEMS – compliant database. We chose to use the SIGMa – GEMS format to have more potential to integrate with other regional and national-scale USGS mapping efforts that are also in that format.

https://pubs.usgs.gov/sir/2022/5115/sir20225115.pdf

*The Geologic Map Schema (GeMS) is the publication and archive database standard for geologic map data funded by the U.S. Geological Survey National Cooperative Geologic Mapping Program, and standardizes the organization and content of a single map database. However, synthesizing multiple databases into a seamless geologic map database creates a different set of challenges and database needs than GeMS was designed to accommodate. The Seamless Integrated Geologic Mapping (SIGMa) extension is designed to expand the capabilities of GeMS by enabling integration of map-based geoscience data. In particular, the SIGMa extension enables capturing a diverse and ever-changing set of map units, produced by many contributors operating independently, and by incremental and noncontiguous assembly and publication. Feature-level metadata fields allow data sources and digital compilation methods to be attributed separately and a relational structure is designed to support the link between data sources and features attributed with multiple data sources. Instead of paragraph-style map-unit descriptions that can be highly inconsistent, SIGMa parses fundamental map-unit attributes, including material, genetic process, and age, into thematically specific fields. The SIGMa extension uses a hierarchical map-unit organization to facilitate a dynamic and evolving, formation-level stratigraphic framework. The hierarchy is developed around geologic provinces that represent temporally restricted geologic events, processes, and settings. Geologic provinces can include magmatic events, depositional settings associated with tectonic processes or stable continental margins, and processes that are actively shaping the modern landscape. A geologic province hierarchy places map units into a geologic context at subregional to continental scales and provides the flexibility to support incremental assembly of the stratigraphy.*

Please note that the map layout will be professionally redone by the USGS publication department. Therefore, focus on reviewing the geologic content, geologic relationships, and map unit descriptions, rather than the current layout details is highly preferred.

The LiDAR data, used as underlay for mapping and in this version is of high accuracy and did not match the older 100k topo base. For review purposes, the LiDAR underlay was chosen as individual beds and ridgelines match the geologic mapping.

Description of Map Units

Geologic Province 1 – Non-deposits

[artificial | water, snow, and ice]

Artificial features include reservoir dams, mine tailings, reclaimed mine sites, disturbance from active mining operations, and other significant construction efforts. Bodies of water, snow, or ice are mostly mapped where they are large or affect the surface

w **water**

af **artificial fill** —Rock fragments and mixed sediment from tailings, reclaimed mines, or reservoir dams

Geologic Province 1 - QUATERNARY DEPOSITS - Surficial Deposits (Quaternary)

Qal **Alluvium (Quaternary)**—Clay, silt, sand, gravel, and conglomerate deposited in streambeds and floodplains

Qt **Alluvium and terrace deposits (Quaternary)**—Clay, silt, sand, gravel, and conglomerate deposited as alluvial deposits on several terrace levels

Geologic province 1 - LAURENTIA-GONDWANA CONVERGENT OROGENIC BASINS **(Permian – Mississippian)**

[foreland basin| structural basin| flexural basin] [sedimentary] [deep to shallow marine depositional system | deltaic depositional system | continental depositional system]

Mississippian to Permian deposition in the foreland basins that formed as a result of continent-to-continent collision of southern Laurentia with Gondwana during assembly of the Pangea supercontinent. (e.g., Thomas, 2014, Lawton and others, 2021). Includes deposits throughout the southern United States, extending from New England, Massachusetts, New York, Pennsylvania, West Virginia, Virginia, Kentucky, Tennessee, Alabama, Mississippi, Arkansas, Oklahoma, Texas, and Sonora, Mexico. Basins include the Sonora Basin, SE Oquirrh basin, Paradox basin, Orogrande basin, Delaware basin, Fort Worth basin, Arkoma basin, Palo Duro basin, Anadarko basin, Black Warrior basin, and Alleghanian basin (Lawton and others, 2021). Deposits are dominated by shales, sandstones, carbonates, and coals, with deep marine, to shallow marine, and continental origins

Geologic Province 2 - Arkoma basin (Middle Pennsylvanian – Late Mississippian)

[foreland | structural basin | shallow to deep marine depositional system | continental depositional system]

Southward thickening depositional wedge related to foreland basin deposition associated with the continent-to-continent collision between the Ozark platform (Laurentia) with Gondwana during assembly of the Pangea supercontinent to form the Ouachita uplift in Arkansas and Oklahoma (Arbenz, 1989; Viele and Thomas, 1989; Sutherland, 1988; Houseknecht, 1986, Lawton and others, 2021). Muddy turbidites from deep water fan systems, are considered first deposits signaling basin formation, marking a distinct change from older carbonate platform deposits (Lowe, 1989). The Arkoma Basin is characterized by an increased and unusually rapid sediment accumulation rate during the middle Atokan (Houseknecht and McGilvary, 1990). Growth faulting due to flexural loading developed during this time (Lutz and others, 2024). Deposits comprise deep water sands and shales, alternating successions of fluvial and shallow marine sands and shales, and occasional limestones in marine, and coalbeds in continental settings

**Geologic Province 3 - Arkoma basin | Foreland Basin (Pennsylvanian)**

[foreland | structural basin | deep to shallow marine depositional system |continental depositional system]

Middle Pennsylvanian clastic sediments deposited into the flexural foreland basin associated with Ouachita orogen. Includes deposits formed during flexural growth faulting as well as wedge top deposition above contractional structures (Houseknecht, 1986). Coalbeds, associated with the upper Atokan and Desmoinesian shallow marine to continental strata have been extensively mined, and several oil fields (in the north), and gas fields (in the main basin where thermal maturity is higher) are present in these units

IPkg **Krebs Group (Pennsylvanian, Desmoinesian)**—Sandstones, shales, carbonaceous shales and coals, deposited in fluvio-deltaic and shallow marine, tidally influenced sedimentary environments

IPbbj **Bluejacket Sandstone Member of Boggy Formation of Krebs Group (Pennsylvanian, Desmoinesian)**— Lower unit of the Boggy Formation capping Short Mountain and Horseshoe Mountain in Logan County. Contains several 2-3m thick sandstone intervals that hold up topographic benches, separated by carbonaceous shale intervals. Sandstones are light grey colored, well-sorted, upper fine grained, quartz-rich lithic arenites, distinguished by higher percentages of mica and lithic fragments than underlying units. A *Lepidodendron* imprint is present in a basal channel form at Short Mountain. Sedimentary structures comprise multidirectional trough and tangential cross bedding, and ripples. Shale and silt intervals often contain thin wavy ripple beds that can be bioturbated. Contact with underlying Savanna Formation gradational. Thickness at least 80-100 ft (25m). Detrital zircon correlations confirm that this is the Bluejacket Sandstone Member of the Boggy Formation (Smith and others, 2024)

IPsv **Savanna Formation of Krebs Group (Pennsylvanian, Desmoinesian)**— Caps Mount Magazine and preserved in several synclines in map area. Basal contact gradational with extensive ripple beds coarsening to medium-to thick bedded light grey sandstones on Mt Magazine. Base of sandstone beds and first cliff former mapped as base of formation. Thickness at least 225 m (740ft) with estimates up to xx ft, top contact rarely preserved and gradational with Boggy Formation. Contains intervals showing multidirectional barforms with abundant ripple cross laminations indicating tidal influence, up to medium-grained planar parallel beds also occur. A cliff forming interval with similar sedimentary structures occurs at Cameron Bluffs near the top of Mt. Magazine. Sandstones are alternated with shale and siltstone and several coalbeds of which the Paris and Cavanal coalbeds have been extensively mined. Both bioturbation and trace fossils common on bed bases. Plant and invertebrate fossils found on several horizons

IPma **McAlester Formation of Krebs Group (Pennsylvanian, Desmoinesian)**— Alternating intervals of predominately shale and light grey sandstone. Basal contact gradational from Hartshorne Sandstone into shales (McCurtain Shale horizon, 60-80ft thick). Contains Lower Hartshorne coalbed above its base. Several laterally continuous sandstone intervals between 30-45ft occur throughout the section (Werner Sandstones, Carter Sandstone equivalent, Suneson and Boyd, 2008 ). These sandstones contain multidirectional bedforms and other tidal signatures, finer-grained intervals often flaser bedded. Trace and plant fossils occur. Upper part shaly and contains McAlester coalbed

IPma **Hartshorne Sandstone of Krebs Group (Pennsylvanian, Desmoinesian)**— Forms distinct sandstone ledge up 300 ft thick in study area. Unit often has a sharp basal contact and an abrupt increase in grainsize to moderately sorted, upper fine and medium, yellow-brown to grey sandstone. Mostly quartz sandstone, however minor lithic fragments and feldspar occur. Contact erosional in places and underlying Atoka shales often coarsen upward towards contact suggesting progradational relationship between shales and sands within one genetic system. Channelform sandstones and minor shale breaks present. Barfoms with internal cross bedding and frequent ripple marks in oblique directions to main flow common. Planar tabular, tangential and climbing ripple cross stratification also occur. Wood fragments and silt and shale rip ups also found. Bed bases commonly loaded

IPa **Atoka Formation (Pennsylvanian, Atokan)**—Succession of predominantly shales and light grey to tan sandstones. Shale and siltstones fissile to wavy bedded, often burrowed, fine-grained sandstones have abundant ripple laminations, burrowing rippled or cross bedded to planar-parallel bedded with parting lineations. Sandstones can be identified as distinct ridges in landscape and divisions in Atoka Formation verified by LiDAR and tied to subsurface mapping (FSGS, 1988)

IPau **Atoka Formation, upper part (Pennsylvanian, upper Atokan)**—Dark grey to light grey shales and sandstones with some coalbeds in southern part of map area. Thickness up to 2200 ft (FSGS, 1988)

IPam **Atoka Formation, middle part (Pennsylvanian, middle Atokan)**—Dark grey to grey shales alternated with light grey to tan sandstones. Lower part of middle part of Atoka Formation is more shaly than upper part that contains several sandstones (Thickess 1900-3500 ft. (FSGS, 1988)

IPal **Atoka Formation, lower part (Pennsylvanian, lower Atokan)**— Dark grey to black shales alternated with sandstones that contain soft sediment clasts, as well as carbonate, crinoid, and shell fragments. Cross bedding in multiple directions, including herringbone cross stratification. Contact with underlying Dye Shale Member of Bloyd Formation sharp in NE part of map area Unit 500-1300ft thick (FSGS, 1988).

**Geologic Province 3 - Arkoma basin | Transitional shallow foreland basin (Pennsylvanian - Mississippian)**

Late Mississipian to Early Pennsylvanian shelf deposits of carbonates mixed with clastic sediments that were mostly sourced from the north associated with possible early stages of Ouachita or Allegheny orogenies. (Sutherland, 1988; Thomas, 1989; Houseknecht; 1986)

IPb **Bloyd Formation (Pennsylvanian, Morrowan)**—Only present in NE part of map area on upthrown side of Mulberry fault zone, inferred from nearby mapping (Chandler and Hutto, 2006a, Chandler and Hutto, 2006b). Divisions of upper, middle and lower Bloyd Formation maintained. Bloyd Formation (Lower Pennsylvanian, Morrowan)—Interbedded sequence of sandstone, siltstone, shale, and limestone beds.

IPbu **Bloyd Formation, upper part (Pennsylvanian, Morrowan)**—Consists of thin ripple-bedded to thick micaceous sandstones, interbedded with dark gray to black shale and siltstone beds. The sandstones consist of fine to coarse-grained sub-angular to sub-rounded quartz. This interval contains many trace fossils and load features. Approximately 200 - 320 ft (60 - 98 m) thick (Chandler and Hutto, 2006a, Chandler and Hutto, 2006b)

IPbm **Bloyd Formation, middle part “middle Bloyd sandstone” (Pennsylvanian, Morrowan)**—Mapped based on thickness and Lidar (inferred from Chandler and Hutto, 2006a, Chandler and Hutto, 2006b). A thin to massive, medium to coarse-grained, cross-bedded quartz or iron-cemented sandstone with sub-angular to sub-rounded quartz grains. Reddish, gray, or light tan on fresh surfaces but weathers brown to orange-brown due to iron content. Cross -bedded intervals can be up to three feet thick and show soft-sediment deformation. Contains abundant rounded white quartz pebbles and wood imprints. A calcite cemented limestone or crinoid-bearing limestone is observed at several locations in nearby areas (Hudson and Turner, 2016). Approximately 80-120 ft (24-37 m) thick.

. IPbl **Bloyd Formation, lower part (Pennsylvanian, Morrowan)** — Predominantly shales and siltstonews with intebedded limestone and thin beds of sandstone. Shale and siltstone are dark gray and fissile to thin; ripple bedded. Sandstone is tan, very fine to fine grained, thin bedded with ripple marks. Limestone includes medium to thick beds of red-brown conglomerate, with clasts of fossil fragments and subrounded sandstone and siltstone. Base not exposed in study area. Approximately 240 - 360 ft (73 – 110 m) thick north of study area

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7.5-minute quadrangles in map area

* Casa 7.5-minute quadrangle
* Caulksville 7.5-minute quadrangle
* Chickalah Mountain East 7.5-minute quadrangle
* Chickalah Mountain West 7.5-minute quadrangle
* Cecil 7.5-minute quadrangle
* Coal Hill 7.5-minute quadrangle
* Danville 7.5-minute quadrangle
* Danville Mountain 7.5-minute quadrangle
* Dardanelle 7.5-minute quadrangle
* Delaware 7.5-minute quadrangle
* Dover 7.5-minute quadrangle
* Havana 7.5-minute quadrangle
* Holla Bend 7.5-minute quadrangle
* Knoxville 7.5-minute quadrangle
* Lee Mountain 7.5-minute quadrangle
* New Blaine 7.5-minute quadrangle
* Ola 7.5-minute quadrangle
* Ozark 7.5-minute quadrangle
* Russellville East 7.5-minute quadrangle
* Russellville West 7.5-minute quadrangle