Petroleum System Modeling of the Western Canada Sedimentary Basin – Isopach Grid Files

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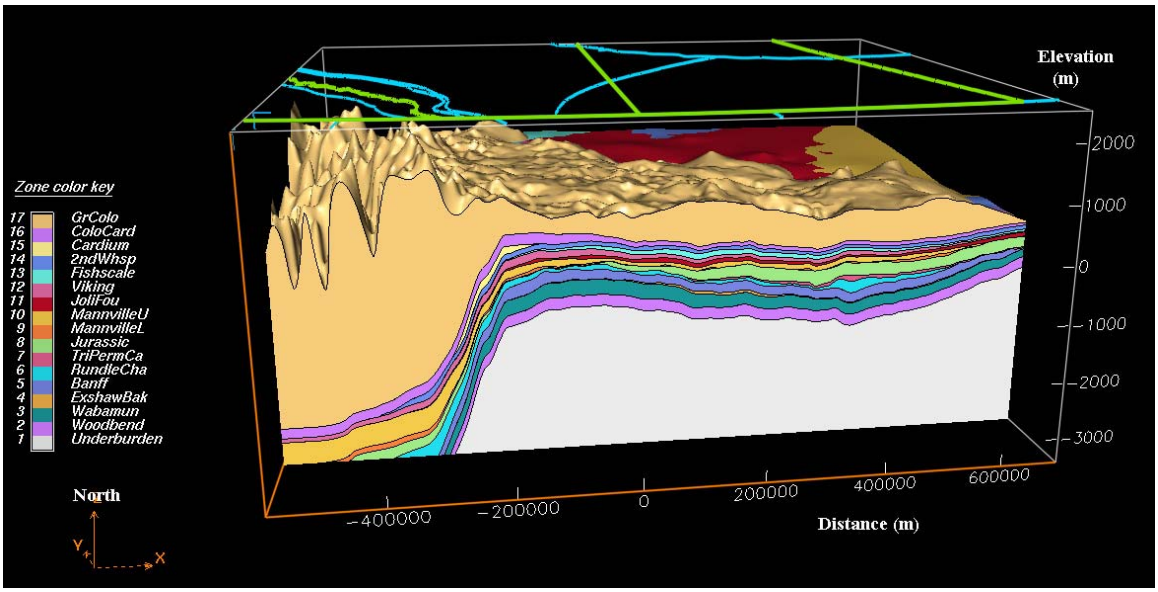

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[Vertical and horizontal scales are in meters. Intervals 17 through 12 are within the Colorado Group. Table is modified from Higley and others (2005).]

Introduction

This publication contains zmap-format grid files of isopach intervals that represent strata associated with Devonian to Holocene petroleum systems of the Western Canada Sedimentary Basin (WCSB) of Alberta, British Columbia, and Saskatchewan, Canada. Also included is one grid file that represents elevations relative to sea level of the top of the Lower Cretaceous Mannville Group. Vertical and lateral scales are in meters. The age range represented by the stratigraphic intervals comprising the grid files is 373 million years ago (Ma) to present day. File names, age ranges, formation intervals, and primary petroleum system elements are listed in table 1.

Metadata associated with this publication includes information on the study area and the zmap-format files. The digital files listed in table 1 were compiled as part of the Petroleum Processes Research Project being conducted by the Central Energy Resources Team of the U.S. Geological Survey, which focuses on modeling petroleum generation,

migration, and accumulation through time for petroleum systems of the WCSB. Primary purposes of the WCSB study are to

1. Construct the 1-D/2-D/3-D petroleum system models of the WCSB. Actual boundaries of the study area are documented within the metadata; excluded are northern Alberta and eastern Saskatchewan, but fringing areas of the United States are included.
2. Publish results of the research and the grid files generated for use in the 3-D model of the WCSB.
3. Evaluate the use of petroleum system modeling in assessing undiscovered oil and gas resources for geologic provinces across the World.

Data Processing Steps

1. Primary data sources for formation tops are (1) Riley (1996); (2) IHS Energy (2004a) for Alberta, British Columbia, and Saskatchewan; (3) IHS Energy (2004b) for the United States; (4) digital isopach and structure datasets from Mossop and Shetsen (1994); and (5) Lexicon of Canadian Stratigraphy (Glass, 1997).
2. Formation names and age ranges change within and across the WCSB province; consequently, retrievals were based on age-equivalent formations. Resulting data files were edited using Environmental Systems Research Institute (ESRI) ArcMap^{tm} and Dynamic Graphics, Inc. (DGI) EarthVision^{tm} software to remove anomalous data, examples of which include location errors, incorrect formation-top elevations and thicknesses of formations, and formation picks that represent upthrust intervals within the Rocky Mountain deformation front.
3. Sources of ground elevations were well records and digital elevation model (DEM) data. Locations of formation outcrops/subcrops were derived primarily from maps in the Geologic Atlas of the Western Canada Sedimentary Basin (Mossop and Shetsen, 1994). Some of the map figures within that publication also contain isopach and structural contours based on outcrop or other studies that were not included within the databases; these contour values were included within our data files for gridding. Also included were zero-thickness locations in areas where the formation intervals were

missing, such as the Precambrian shield. Interval thicknesses and extent of unmapped formations under the Rocky Mountains were extrapolated or interpolated in DGI EarthVision[tm] software.

4. 2-D isopach and structural grids were generated from the edited files by the DGI EarthVision[tm] Briggs Biharmonic Spline algorithm; as many as 15 data values were evaluated from each grid node. Vertical (y) and horizontal (x) scales are in meters. The respective x and y grid spacing is 1,000.00 m and 1,009.45 m.
5. Negative isopach values sometimes occur in the grid files in extrapolated areas where data are lacking. These extrapolated values were replaced by zero thickness because of requirements of the EarthVision[tm] geologic and Integrated Exploration Services (IES) PetroMod[tm] petroleum system 3-D modeling software.
6. Isopach and structure maps that were generated with EarthVision[tm] software were compared to published cross sections and maps, and anomalous surfaces were corrected by editing the scattered data files and regridding the files.
7. Final grid files were converted to zmap format for input into a 3-D petroleum system model of the WCSB that was created with IES PetroMod[tm].

Zmap-Format Grid Files

Table 1 contains names of the 18 zmap-format grid files associated with this publication. Zmap file headers include (1) a comment section with original file names and locations, file creation date and time, and (2) original file name and folder, file type, grid spacing, and coordinate information. File structure is a series of rows and columns with values listed for each grid cell. Included data and coordinates are incorporated by using software that reads zmap-format files. Software programs are available to import and convert zmap-format files. These grid formats can be read by EarthVision[tm], ArcMap[tm], and PetroMod[tm] software, for example. Metadata are saved in text and .xml format, the latter of which is readable using ESRI software.

Acknowledgments

Jennie Ridgley, USGS, assisted us greatly with her knowledge of the geologic history of the WCSB, and access to her Rileys database. Gregg Gunther and Laura Biewick provided excellent reviews of the text and metadata. Douglas Steinshouer helped with editing scattered data files using ESRI ArcMap[tm] and ArcGIS[tm].

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Table 1. 3-D petroleum system model interval number (No.), zmap-format grid file name (DAT file name), age ranges of stratigraphic-unit (depositional) and erosional intervals in millions of years (Ma), and primary petroleum system characteristics of reservoir, seal, source, overburden, and underburden rocks.

[Vertical and horizontal scales are in meters. Intervals 17 through 12 are within the Colorado Group. Table is modified from Higley and others (2005).]

No.	DAT file name	Age (Ma) from	to	Stratigraphic/erosional interval	Petroleum system elements
18	Erosion	57.8	1.6	Estimated eroded thickness of Eocene through Holocene sediments	Overburden
17	GrColoiso	80	57.8	Ground surface to the top of Colorado Group	Overburden
16	ColoCard	88	80	Top Colorado Group to top of Cardium Formation	Seal
15	Card2Whsp	91	88	Top of Cardium Formation to top of Second White Speckled Shale	Reservoir
14	2WhsBFscale	97	91	Top of Second White Speckled Shale to base of Fish Scale marker	Source/seal/reservoir
13	Westgate	99	97	Base of Fish Scale marker to top of Viking Formation	Source/seal
12	Viking	101	99	Viking to top of Joli Fou Formations	Reservoir
11	JoliFou	105	101	Top of Joli Fou Formation to top of Mannville Group	Seal
10	MannElev			Elevation on Mannville Group	
9	UMann	113	105	Upper Mannville Group	Source/reservoir
8	LMann	119	113	Lower Mannville Group	Source/reservoir
		150	119	Sub-Mannville unconformity	
7	Jurassic	208	150	Jurassic formations	Source/seal/reservoir
6	TriasPermC	321	208	Triassic, Permian, Pennsylvanian and Upper Mississippian formations	Source/seal/reservoir
5	RundleChar	345	321	Rundle Group	Source/reservoir
4	Banff	357	345	Banff Formation	Source/seal/reservoir
3	ExshBak	362	357	Exshaw and Bakken Formations	Source/reservoir
2	WabWinter	369	362	Wabamun and Palliser Formations through the Winterburn Group	Source/seal/reservoir
1	Woodbend	373	369	Woodbend Group	Source/seal/reservoir