

Idaho Geological Survey

Oil & Gas Program

GEONOTE 46

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Oil & Gas Program: Mission

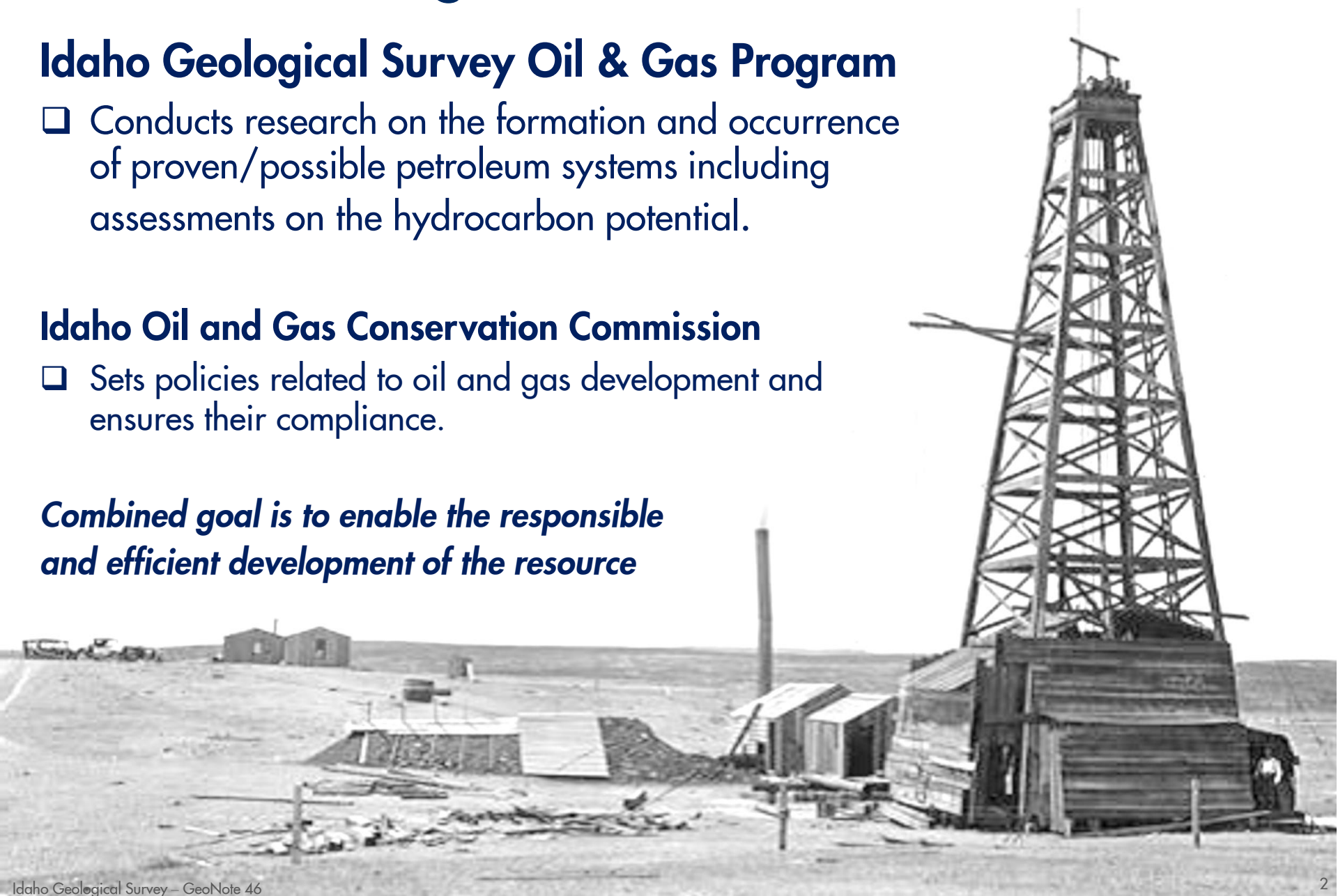
Idaho Geological Survey Oil & Gas Program

- ❑ Conducts research on the formation and occurrence of proven/possible petroleum systems including assessments on the hydrocarbon potential.

Idaho Oil and Gas Conservation Commission

- ❑ Sets policies related to oil and gas development and ensures their compliance.

Combined goal is to enable the responsible and efficient development of the resource



IGS Oil & Gas Program: Activities

- Conducting primary research on the formation and occurrence of proven and possible petroleum systems.
- Preparing assessments on the hydrocarbon potential of select geologic provinces.
- Storing, archiving, and disseminating a wide variety of subsurface geological data.
- Transferring knowledge and information to operators, scientists, policy makers, and the public.

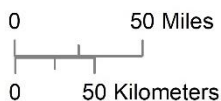
Idaho Oil and Gas Exploration

Oil and Gas Plays

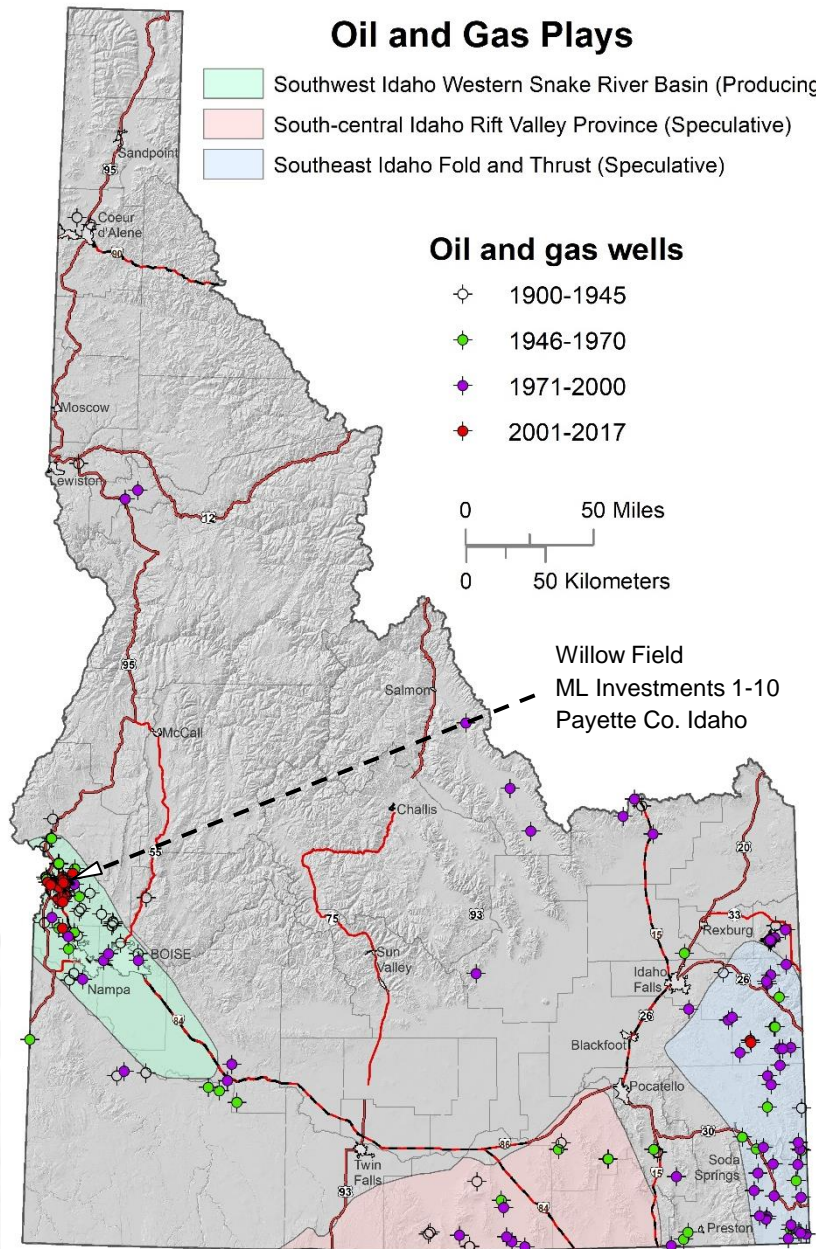
- Southwest Idaho Western Snake River Basin (Producing)
- South-central Idaho Rift Valley Province (Speculative)
- Southeast Idaho Fold and Thrust (Speculative)

Oil and gas wells

- 1900-1945
- 1946-1970
- 1971-2000
- 2001-2017



Willow Field
ML Investments 1-10
Payette Co. Idaho



Over 180 oil/gas exploration wells have been drilled since 1903 with activity closely corresponding to historic price spikes.

Currently, there are three regions of active leasing and/or drilling with one area proven (Southwest Idaho) and the other two speculative (South-central and Southeast Idaho).

The first successful well (M L Investments 1-10) was drilled in the **SW Idaho Play** in 2010 by Bridge Energy. In 2012 Bridge's SW Idaho holdings were sold to Alta Mesa Resources and Snake River Oil. Conventional production of natural gas, condensate, and oil commenced from the Willow Field, Payette County, in 2015.

The **SE Idaho play** is an extension of the *Fold and Thrust*, a proven play in SW Wyoming. There has been a number of conventional prospects tested (drilled) but no commercial successes to date. Potential for an unevaluated unconventional play may also exist.

The **South-central Play** is highly speculative and defined by the association of several large structures and well-known Paleozoic source rocks. No prospects have been tested.

IGS Oil & Gas Research

Basin Analysis

- Analysis based on an integration of seismic, well, and field mapping data. Goal is to establish a 3D stratigraphic/tectonic framework of the Western Snake River Plain (WSRP) and its evolution through time. Framework will define the petroleum system in terms of reservoirs, seals, and source rocks (SR).

Reservoir Characterization and Performance

- Work combines information from 2D seismic images of the subsurface with drone imagery from outcrop analogs to document the facies architecture and tectono-stratigraphic setting of reservoir analogs. Data will be integrated with field production to help risk and rank future subsurface targets.

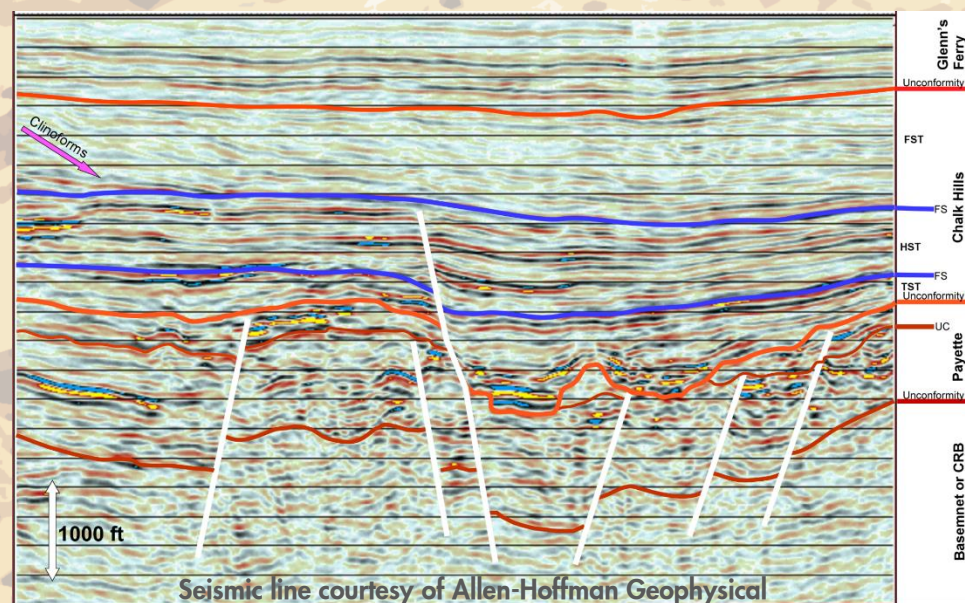
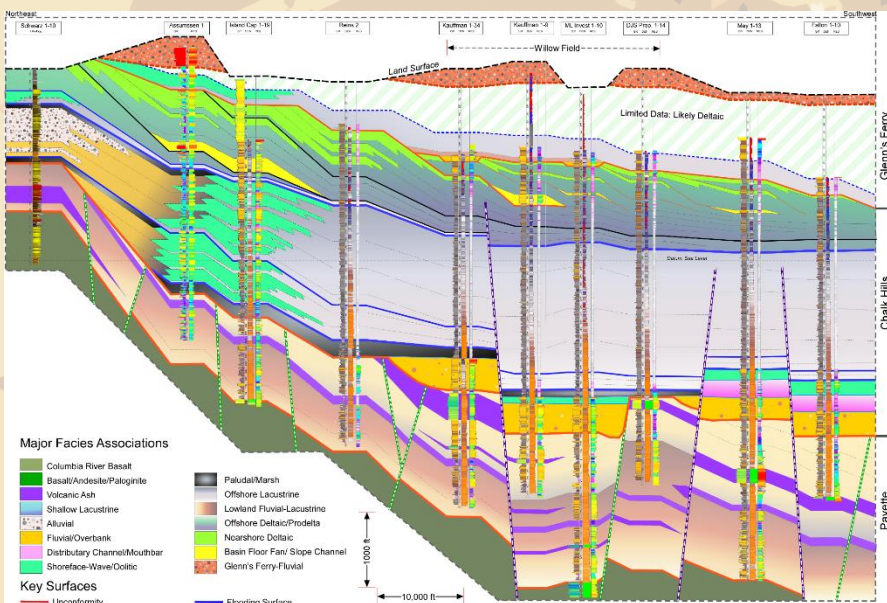
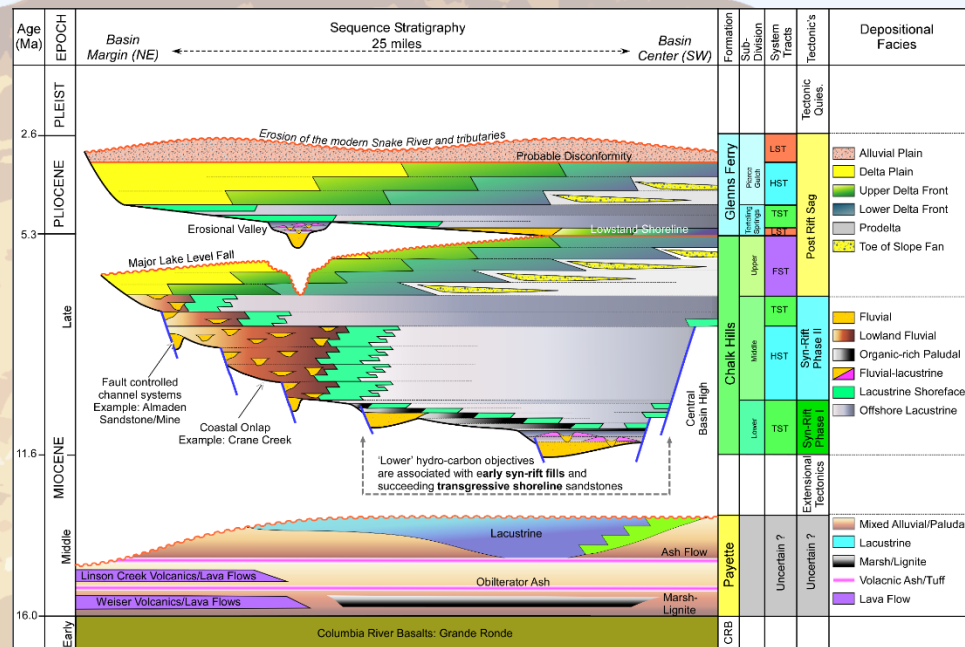
Source Rock Evaluation

- Geochemical characterization of produced hydrocarbons and potential source rocks. Information will help identify the origins of oil and gas and hydrocarbon generating capabilities of SR.

**Current focus
is on the
Western
Snake River
Plain (WSRP),
SW Idaho**

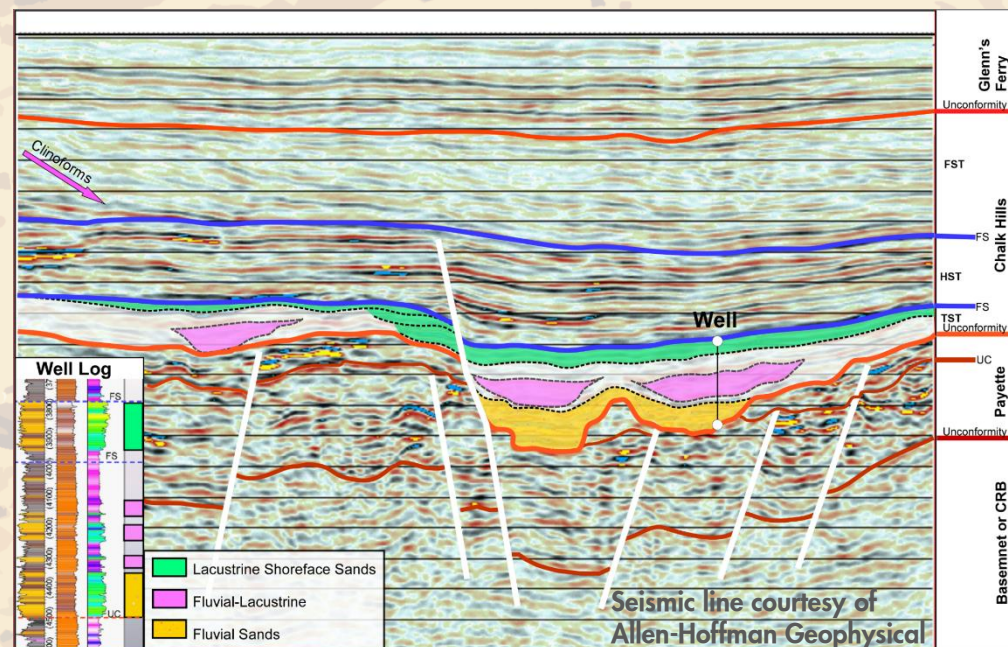
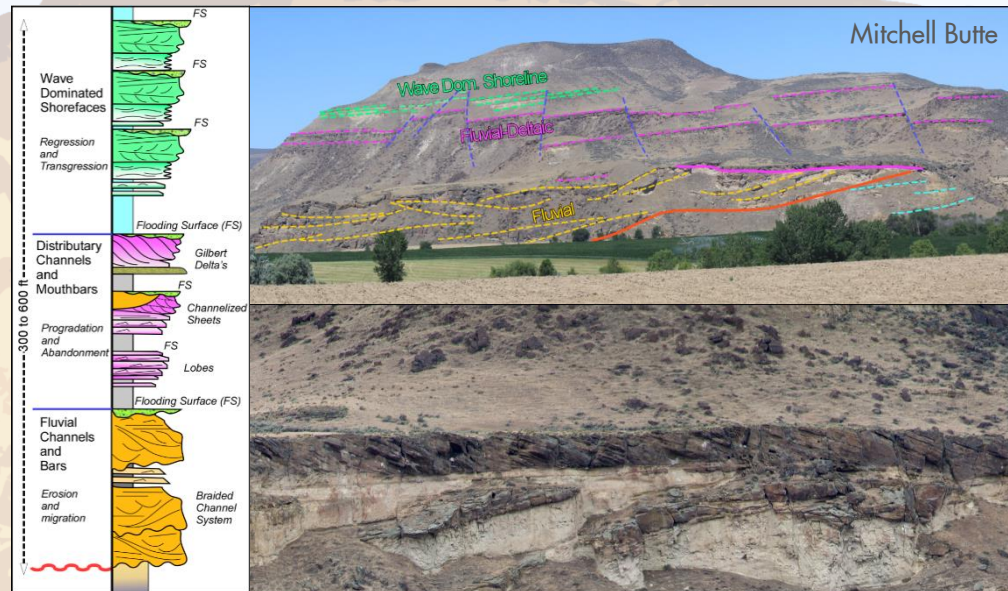
Basin Analysis

- ❑ The basin fill of the WSRP and its evolution through time is illustrated in the chrono-stratigraphic chart (upper-right diagram).
- ❑ Known hydrocarbon reservoirs are associated with the lower Chalk Hills, syn-rift fills and upper Chalk Hills toe-of-slope fans. Payette age reservoirs also potentially exist.
- ❑ Stratigraphic relationships have been extended to well log and seismic data sets and highlighted below.
- ❑ Long term goal is to construct a 3D stratigraphic framework of the basin. Framework will assist any future activity (Oil&Gas, Groundwater, Gas Storage, Geothermal, Waste Disposal) that requires knowledge of the deep subsurface.



Reservoir Characterization

- Outcrop characterization of seismic-scale, syn-rift reservoir analogs is in progress (*i.e. Mitchell Butte in eastern Oregon, Castle Creek in Southern Idaho*).
- Drone photogrammetry is being examined as a tool for building virtual outcrop models that can be used to illustrate and document complex structural and stratigraphic relationships.
- Information will be integrated with seismic and field production data to predict reservoir performance and rank potential prospects.
- Analog information from the WSRP is applicable to syn-rift settings worldwide as the evolution and architecture of these reservoirs is poorly understood.

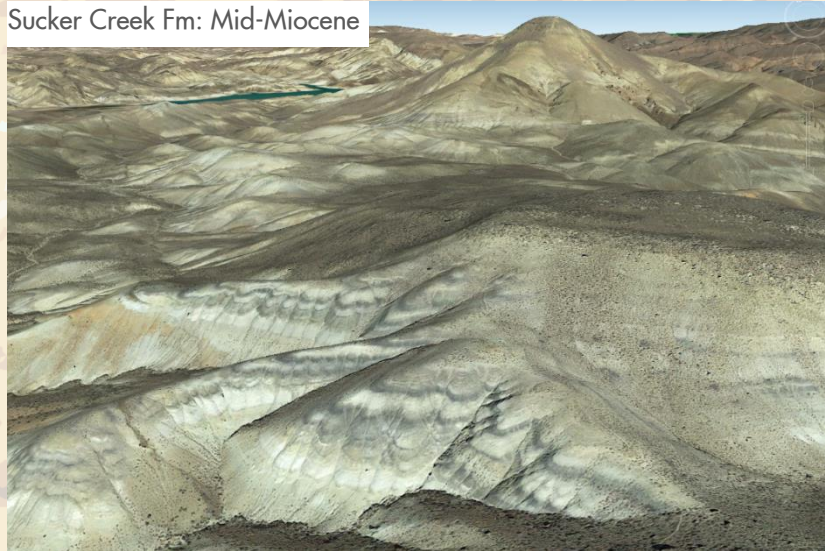


Source Rock Evaluation

- ❑ Gas Chromatography (GC) and Mass Spectrometry (MS) of produced hydrocarbons at the Willow and Hamilton fields and Rock-Eval Pyrolysis of well cuttings and outcrop samples is in progress.
- ❑ Results from the GC/GCMS analysis will help identify the source of the hydrocarbons and at what depth and temperature they initially formed. Rock-Eval Pyrolysis of well and outcrop samples will provide information (TOC, HI index, kerogen type) on the hydrocarbon generating capabilities of potential source rocks.
- ❑ Data from well logs, seismic, and outcrops will be used to map the thickness and distribution of potential source rocks in the subsurface and help identify areas that are prone to producing hydrocarbons from those that are not.

Dark gray intervals seen in outcrop exposures represent organic-rich strata that in the subsurface could be capable of generating hydrocarbons. Outcrops also provide information of the depositional, stratigraphic, and tectonic setting of potential SR that may help in define their thickness and distribution in the subsurface.

Sucker Creek Fm: Mid-Miocene



Payette Fm.: Mid Miocene, Horseshoe Bend



Liquid condensate samples from the Willow Field
Sample collection was assisted and permitted by the operator
High Mesa Holdings.



Oil & Gas Program: Research Summary

Element	Results (2019)	Near-term Plans	Long-term Plans
Basin Analysis	Sequence stratigraphic framework established and extended to all relevant wells within the WSRP	Extend stratigraphic framework and correlations to 2D seismic	Integrate seismic interpretations into a 3D model of the WSRB
Reservoir Characterization	<p>Outcrop investigations underway at Mitchell Butte and Deer Butte</p> <p>Drone Photogrammetry collected and processed for a portion of Mitchell Butte</p>	<p>Complete outcrop description and drone photogrammetry from select locations (i.e. Mitchell Butte, Deer Butte, Chalk Butte, Vale Buttes, and Castle Creek)</p> <p>Integrate analog data with 2D seismic and production data</p>	Rank/risk production performance of potential prospects and plays
Source Rock Evaluation	<p>Geochemical analysis of produced hydrocarbons completed on 11 wells from the Willow and Hamilton Fields</p> <p>Rock-Eval Analysis completed on 15 well-cutting samples and 2 outcrop samples.</p> <p>Vitrinite Reflectance completed on 11 well cutting samples.</p>	<p>Geochemical analysis of produced hydrocarbons from Kauffman 1-9 and Fallon 1-11</p> <p>Geochemical and Rock-Eval analysis of select well cuttings (TBD)</p> <p>Investigate the depositional/tectonic setting of organic-rich zones within Payette and Lower Chalk Hills Formations from outcrop/seismic</p>	<p>Estimate/map distribution and volume of potential source rocks within the WSRB</p> <p>Carry out Basin Modeling of select wells (1D) and seismic lines (2D)</p>

Oil & Gas Program: Collaborations

Basin Analysis

- ❑ Reed Lewis and Dennis Feeney: Idaho Geological Survey (Regional Geologic Mapping)
- ❑ Jim Allen: Allen-Hoffman Geophysical
- ❑ David Smith: High Mesa Holdings
- ❑ Spencer Wood: Emeritus Professor, Boise State University
- ❑ Renee Love: University of Idaho (Palynology)
- ❑ Barbara Nash: University of Utah (Ash Geochemistry/Dating)
- ❑ Jeffery Stone: University of Indiana (Diatom Biostratigraphy)

Reservoir Characterization and Performance

- ❑ Zach Lifton and Claudio Berti: Idaho Geological Survey (Drone Photogrammetry)
- ❑ Jim Allen: Allen-Hoffman Geophysical
- ❑ David Smith: High Mesa Holdings