

### Passive Acoustic Metamaterial Proppants for Advanced Hydraulic Fracture Diagnostics DE- SC0017738

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U.S. Department of Energy National Energy Technology Laboratory **Oil & Natural Gas 2020 Integrated Review Webinar** 



## **Program Overview**

- Funding DOE SBIR Phases I+II
  DOE \$1,750,000.00
  CS \$0.00
- Project Performance Dates
  Phase I: June 12, 2017 March 3, 2018
  Phase II: August 27, 2018 February 26, 2021
- Project Participants
  Oceanit Laboratories, Inc.



# **Program Overview**

- Overall Project Objectives
- Economic and environmental costs that burden the natural gas economy:
  - 1. Ineffective hydraulic fracture jobs
  - 2. Lost injected materials
  - 3. Workover jobs
  - 4. Well downtimes



- Poor zonal isolation and production control threaten environmental and public health.
- Understanding the well state is critical to predicting environmental risks and improving productivity.
- Current proppants and tools do not consistently provide a fully detailed and accurate description of fractures.



# **Program Overview**

### - Overall Project Objectives





#### Features:

- Added at low levels to traditional proppant
- Safe and environmentally benign
- Detection through standard acoustic logging
- Uniform size and shape
- Thermal and chemical resistance
- Low cost starting materials and production methods

#### **Benefits:**

- High resolution propped fracture measurements
- High sensitivity and contrast
- No pretreatment log
- Measurements throughout life of well



# **Technology Background**

#### Acoustic Metamaterials – Enable Unique Acoustic Signatures





# **Technology Background**

#### Laboratory Scale Testing



# Technical Approach/Project Scope

Technical Approach: Acoustic Metamaterials for Hydraulic Fracturing

Project Scope: Develop advanced hydraulic fracture diagnostics technology in preparation for field deployment with industry partners

The project has the following milestones:

- 1. Laboratory acoustic characterization of smart proppant (Month 5)
- 2. Scaled up production (100s of kgs) of smart proppant (Month 7)
- 3. Pilot field testing results for smart proppant (Month 12)
- 4. Scaled-up production (100s of kgs) of refined smart proppant. (Month 17)
- 5. Pilot field testing results for refined smart proppant. (Month 20)
- 6. Full characterization of smart proppant for field study. (Month 22)



#### Tunable metamaterial filler particles for multiple O&G applications





#### Pilot scale seismic study of VuFrac technology







#### Pilot scale seismic study of VuFrac technology





#### Pilot scale seismic study of VuFrac technology







Dissemination of technology:

• IPTC 2020 Booth

Scale-up of production capabilities:

- Multi-layer particles with tunable properties
- Multiple coating methods
- Functional proppant characteristics

Industry engagement resulted in use cases:

- Gravel packed screens
- Near wellbore
- Fracture mapping





## Summary

Oceanit's advanced materials team has developed a sensing technology for mapping proppant distribution in formations away from the wellbore in unconventional gas wells.

VuFrac is added to proppant mixtures during well completion to aid the operator in assessing proppant distribution and environmental conditions, providing specific data that is not currently available to the industry.

Through enhanced knowledge of proppant and geophysical conditions, VuFrac communicates the geometry and behavior of the propped fracture, including aspects like proppant bed height, coverage and flow directions, perforation efficiency, and details of wellbore connectivity.

VuFrac converts traditional proppant into a smart proppant that enables logging of distribution using currently-available logging tools as often as desired during the life of the well with no pretreatment log.



# Appendix

- These slides will not be discussed during the presentation, but are mandatory.



# **Organization Chart**

- Technical
  - Dr. Jacob Pollock
  - Dr. Bryce Davis
  - Dr. Kathryn Anderson
  - Dr. Michael Hadmack
  - Mr. Jordan Moniuszko

- Management
  - Dr. Vinod Veedu
  - Mr. Derek Ah Yo

- Commercialization
  - Dr. Glen Nakafuji
  - Mr. Matthew Sullivan
  - Mr. Stefan Mrozewski



### Gantt Chart

	Month																							
Task	BP1										BP2													
	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24
1. Smart proppant particle production																								
2. Acoustic testing of proppant mixtures under load						7																		
3. Scaled-up smart proppant production								2										4						
4. Pilot field study with buried proppant under load												4	7								4			
5. Commercialization transition planning and scale-up																								
6. Proppant physical characterization																						4		
7. Acoustic tool selection and customization for measurement																								
8. Reporting and project management																								

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