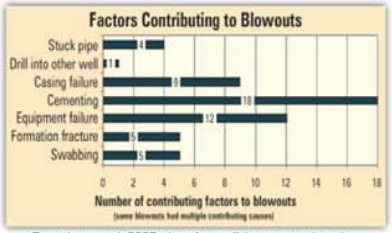
# Enhancing Wellbore Stability

## Technology/Capability Overview

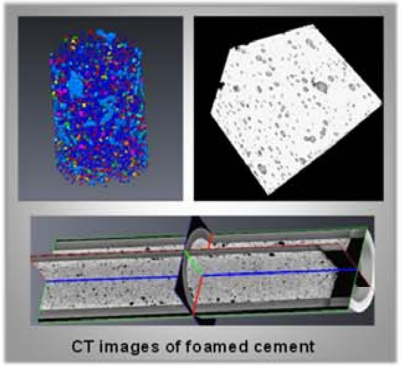
- NETL has a long history of wellbore cement integrity research. Past projects include:
  - Cement alteration under *in situ* $CO_2$ and/or $H_2S$-$CO_2$ storage conditions (Kutchko *et al.*, 2007, 2008, 2009, 2011; Huerta et al., 2012)
- In FY12/13 we have kicked off new work in shale gas and ultra-deepwater wellbore integrity. NETL-RUA has cutting edge facilities to conduct wellbore integrity research:
  - HP/HT experimental laboratories and extensive experience working with HP/HT fluids, gases, cement interactions
  - Material characterization using XRD and SEM-EDS,
  - CT Scanners providing 3D imaging data at a variety of physical scales.
  - Geomechanical and Flow Laboratory to measure permeability, stress and strain relationship, and Poisson's ratio of samples under HP/HT conditions.
- Current research to determine foam cement stability at various depths in the well and correlate properties with current API method of testing is highlighted here

## Industry Significance

- There is a significant lack in understanding of the stability and properties of foamed cement as it is placed in the well and post-placement.
- The increased use of foamed cement systems in high-stress environments makes understanding their stability in the wellbore vital. Unstable foams can result in failure to achieve zonal isolation.
- Significant industry collaboration effort in this project including: *Baker Hughes*, *Benge Consultants, Inc.*, *BP*, *Schlumberger*, *Chevron*, and ongoing coordinated efforts with BSEE




From Izon et al. 2007, data from offshore operations in the Gulf of Mexico spanning 1992 - 2006

CT images of foamed cement

NETL's Industrial CT-Scanner

NETL has extensive high PT reaction facilities

## Benefits to Partner

- Laboratory experiments are being performed to study the properties of foamed cements at various pressures, shear rates, and foam qualities.
- Utilizes NETL's industrial computer tomography (CT) scanner to provide 3-D image data sets of bubble size distribution of laboratory generated foamed cement under a range of pressures across a similar range of foam qualities
- Determine foam stability at conditions simulating various depths in the well and correlate those properties with the current method of atmospheric testing.
- This study is unique in that bubble size distributions will be measured from high resolution 3D imagery under pressure.
- To determine the spatial distribution of gas bubbles and its impact on properties and failure probability.
- Transferring knowledge of the bubble distribution at laboratory conditions to field conditions at depth, where the gas fraction of foam decreases due to high pressure.
- This research will provide industry the knowledge to ensure safe operation of deep/ultra-deep offshore wells in which foamed cement systems are used.

## Opportunity

- Fact Sheet prepared: *Evaluation of Foamed Wellbore Cement Stability under Deep Water Conditions (R&D 187)*
- Abstract submitted to OTC (Offshore Technology Conference):
- NDA with Schlumberger
- Cement Assessment Report: _www.netl.doe.gov/onsite_research

## Contact

**Barbara Kutchko, NETL, barbara.kutchko@netl.doe.gov**
Team: *NETL* – Brian Strazisar, Eilis Rosenbaum, Dustin McIntyre; *URS* – Dustin Crandall, Bryan Tennant, Magdalena Gill; *ORISE* – Richard Spaulding, Matthew Dieterich; *CMU* – Craig Maloney