



# *Geophysical Society of Pittsburgh*



*Proudly Presents Tuesday, February 3, 2015*

*At*

*Cefalo's Restaurant, Carnegie, PA*

## **Hard Rock AVO Theory and Practice**

**Paul McColgan, PhD**

**McColgan Seismic Interpretation Services, Inc.**

**Abstract:** Many in the industry have heard the term “AVO”, yet few have actually worked with it, and even fewer know what it truly means. Virtually no one is prospecting onshore seismic data with this method due to previous failures of the 1980's; which left behind the notion that the rocks are too fast? It wasn't that the rocks were too fast, it was more-so a problem with the lack of necessary computer power and software to accurately process and interpret pre-stack data. Pre-stack interpretation is a time intensive, data intensive, and computer intensive process. Therefore most interpreters avoid it. Onshore data has two main problems over its offshore equivalent; very high levels of noise and much higher frequencies. Both problems require intense computational time in order bring the signal quality of the data up to the levels necessary to accurately interpret for amplitude anomalies. For example, a standard processing flow for onshore AVO requires: refraction statics, surface consistent statics, pre-stack time migration (PSTM) with 30 to 60 common offsets, ground-roll attenuation, multiple attenuation, random noise attenuation, and frequency enhancement.

One of the most important aspects of prospecting for AVO anomalies in hard rock country is the fact that the majority of the anomalies fall within the Class II category, and as such, do not stand out as so-called bright spots on the stack. More importantly, Class II AVO anomalies have a tendency to stack in at amplitudes no greater than background or in some cases stack out to zero; leaving a myriad of prospects to be found by those willing to make the effort to illuminate the anomalies properly. So what was an unfortunate legacy for some can be a significant opportunity for others as it is often quite possible, if not probable, to find high quality prospects in seismic data 15 to 25 years old which have been overlooked by numerous interpreters.

One goal of this presentation is to remove some of the confusion related to AVO as it pertains to hard rocks by presenting the basic scientific concepts in a manner most can relate to, and then tying these concepts directly to producing analogs of: sandstone, limestone, crystalline dolomite, shale, and even metamorphics. A final goal is to make clear the proper methodology of AVO interpretation in order to avoid a repeat of past mistakes and make use of it to find high quality prospects on a repeatable basis.



**Biography:** *I was born in Philadelphia Pennsylvania where I entered the United States Air Force in 1986 as a jet engine mechanic. I served all my time at Edwards Air Force Base, in Southern California. I returned to Pennsylvania after leaving active duty and completed my BS degree in Earth Science at Penn State University in 1993. Shortly after completing my degree, I moved to Cincinnati Ohio to get married to my wife of 18 years. I worked in the environmental field for three years until completing my MS degree in geoscience in 1999 at Wright State University, Dayton Ohio. Immediately afterward I took a job with Marathon Oil in Oklahoma City as a geophysicist. During my time at Marathon, I performed complex structural interpretations of Wichita Mountain-Front, as well as structural and stratigraphic interpretations of the Anadarko Basin. It was during this time where I began to get heavily involved in depth migration for the complexities of the mountain-front, and AVO methods for the Anadarko Basin. As part of the process I began working on my PhD at the University of Oklahoma where my focus was on AVO in carbonates. I stayed with the company for nearly five years until they closed and moved the OKC operations to the Houston office.*

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*Cost: \$35 Members, \$40 Non-members (\$20 for Students). Meeting Location: 428 Washington Ave, Carnegie, PA 15106 (412) 276-6600*

**McColgan Biography (continued)** I was immediately offered a position at Chesapeake Energy in OKC as a geophysicist for their newly formed Gulf Coast division. Chesapeake was a very aggressive company at the time and spared no expense to get things done. As such, I was able to take my ideas in AVO and depth migration from theory to practice with an active drilling program on 1,500 square miles of spec seismic data. The exploration focus was on natural gas, where the use of AVO was very applicable and fairly well understood in the Texas Gulf Coast region. As such our group had a commercial success rate on the order of 90% using the method. In 2007 I left Chesapeake to take a geophysical position with Tom Ward (cofounder of Chesapeake Energy) at his newly formed SandRidge Energy. There, I began working the relatively unknown Mississippian oil play. While AVO was not useful for this play, standard acoustic impedance inversion was, making it relatively easy to delineate high quality reservoir rock from poor. I worked at SandRidge for a period of eight months before starting my own business as an independent geophysical consultant in 2008. I finished my PhD at the University of Oklahoma in 2009. Since that time I've been refining my methods of processing and interpretation of hard rock AVO and shifted its application from gas only prospects to oil. One of the more exciting areas I've been focusing during the past five years is in the San Joaquin Valley, where production of oil is simply phenomenal in range of depth, number of producing zones, and reservoir types. I have no plans for retirement as I essentially already have. Prospecting for oil and gas is challenging, rewarding, and simply great fun.....couldn't ask for a better job!.

## ***Tuesday February 3, 2015 Agenda***

***5:00 pm Social Hour sponsored by***

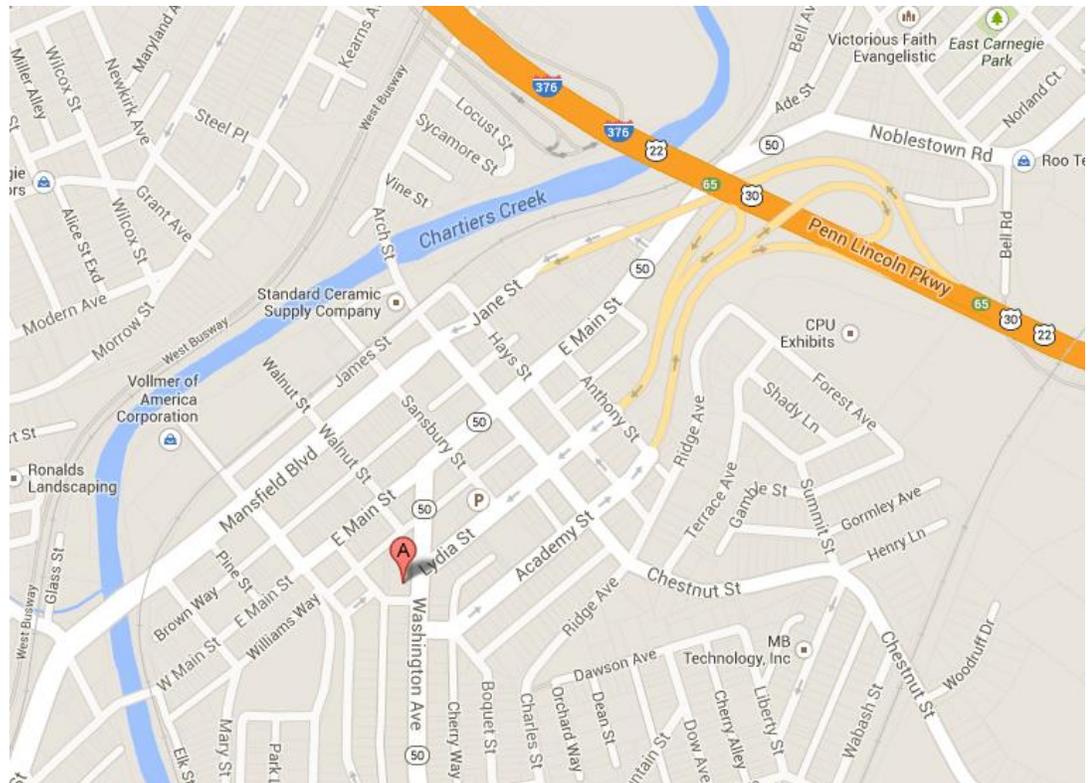


***6:00 pm Dinner Buffet***

***7:00 pm Lecture***

***This months lecture will be held at :***

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