



Cloud-to-Ground Lightning:

A Newly Recognized Natural Resource Exploration Tool

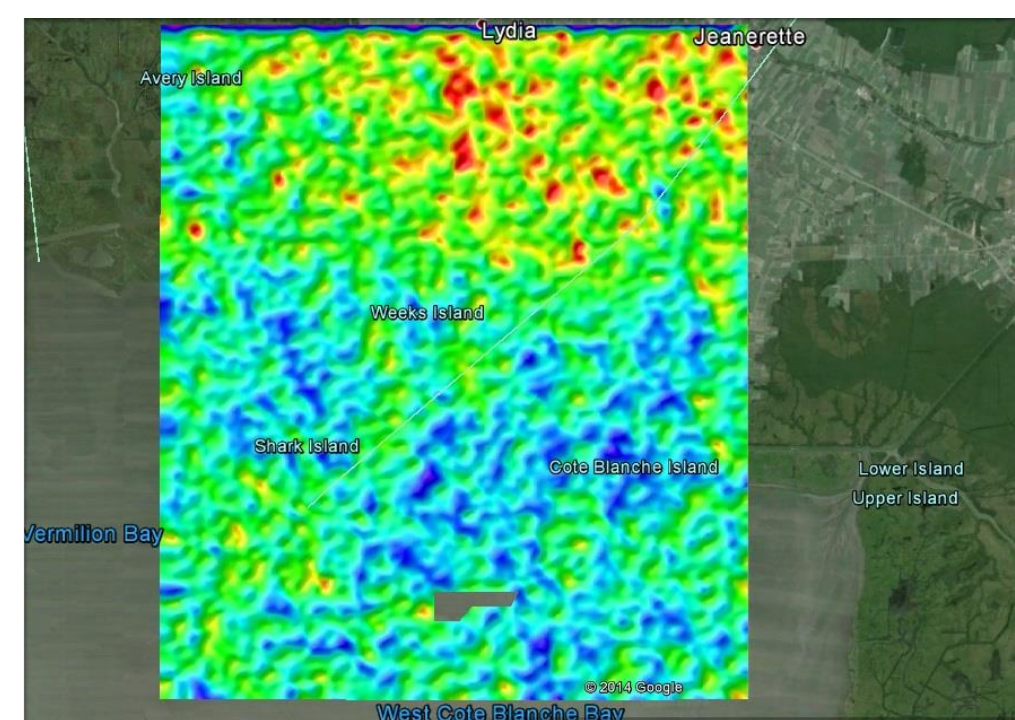
Dynamic Measurement, LLC



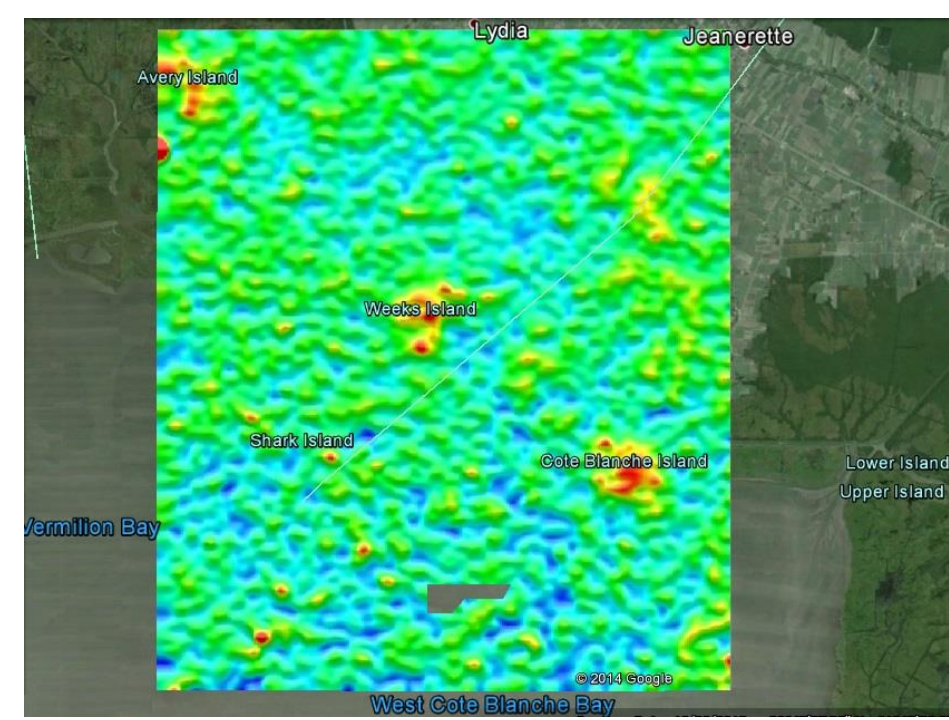
Introduction

Lightning is a meteorological phenomenon. However, lightning strike location and lightning strike attributes appear to be influenced, if not controlled, by geology.

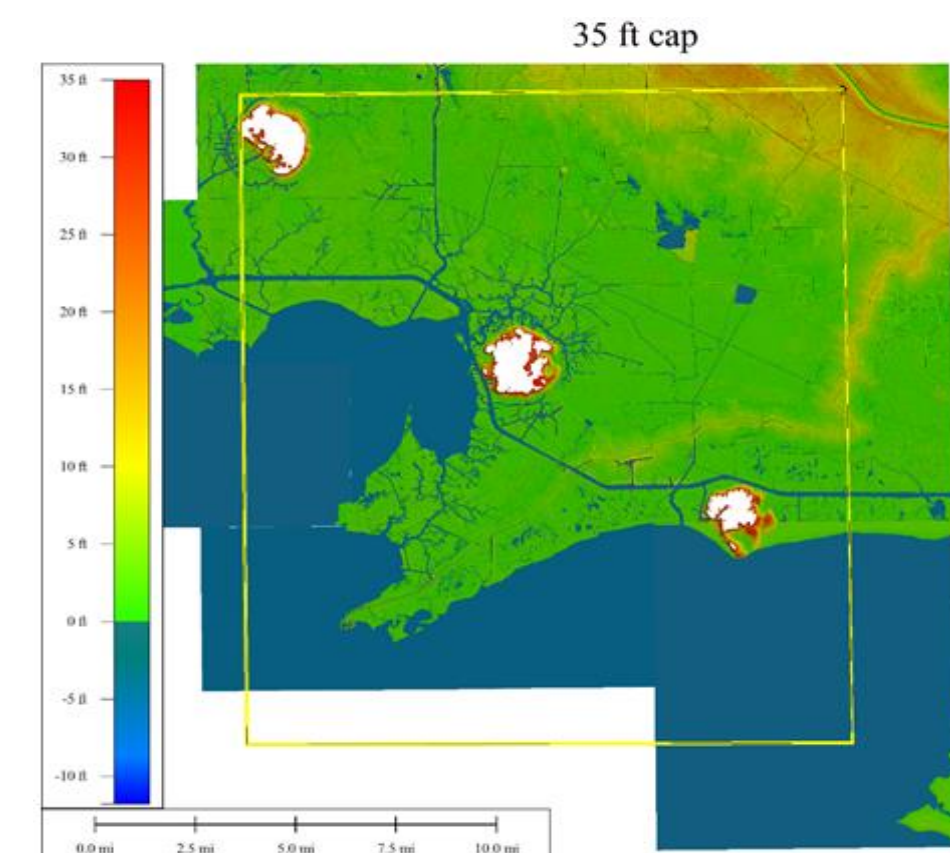
The result was the creation of the National Lightning Detection Network (NLDN), and recent advances in measuring ability has opened the door to data mine and map millions of lightning strikes. This has shown geology influences strike locations and attributes. When various attributes are mapped from databases from Florida, Louisiana, Michigan, New York, North Dakota, and Texas patterns have been identified. Lightning strike density varies spatially, and these variations are somewhat consistent over time. Key attributes are used to identify geologic features.



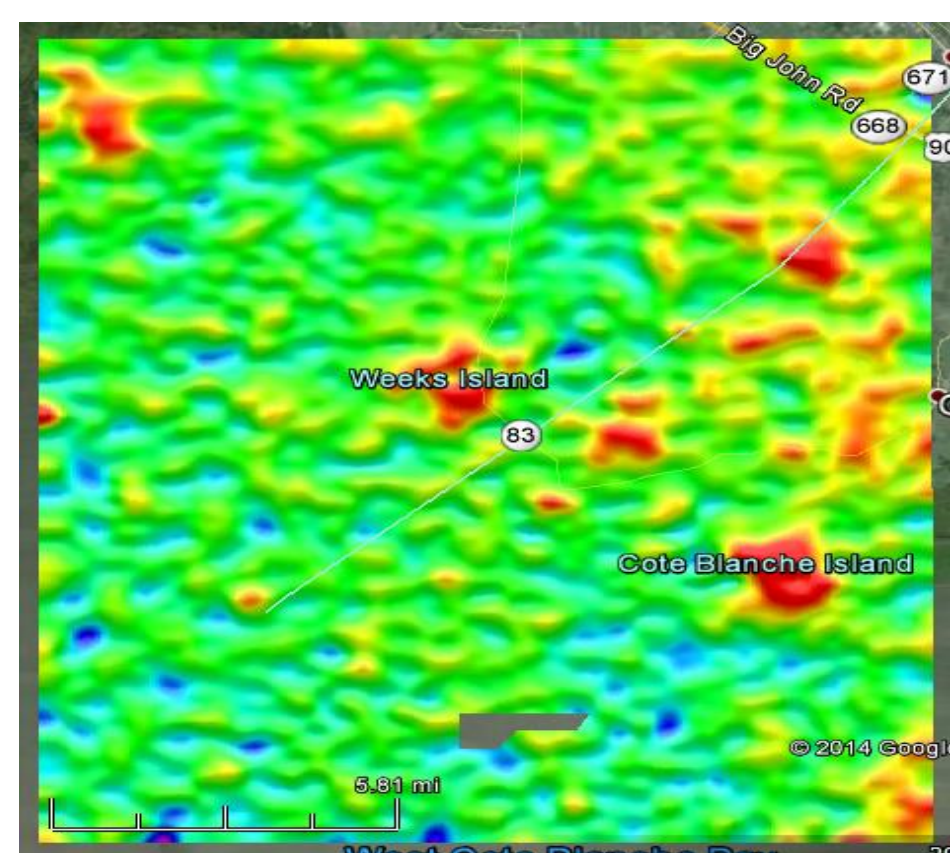
Louisiana Lightning Strike Density



Louisiana Lightning Rise Time Highlights Subsurface Salt Domes



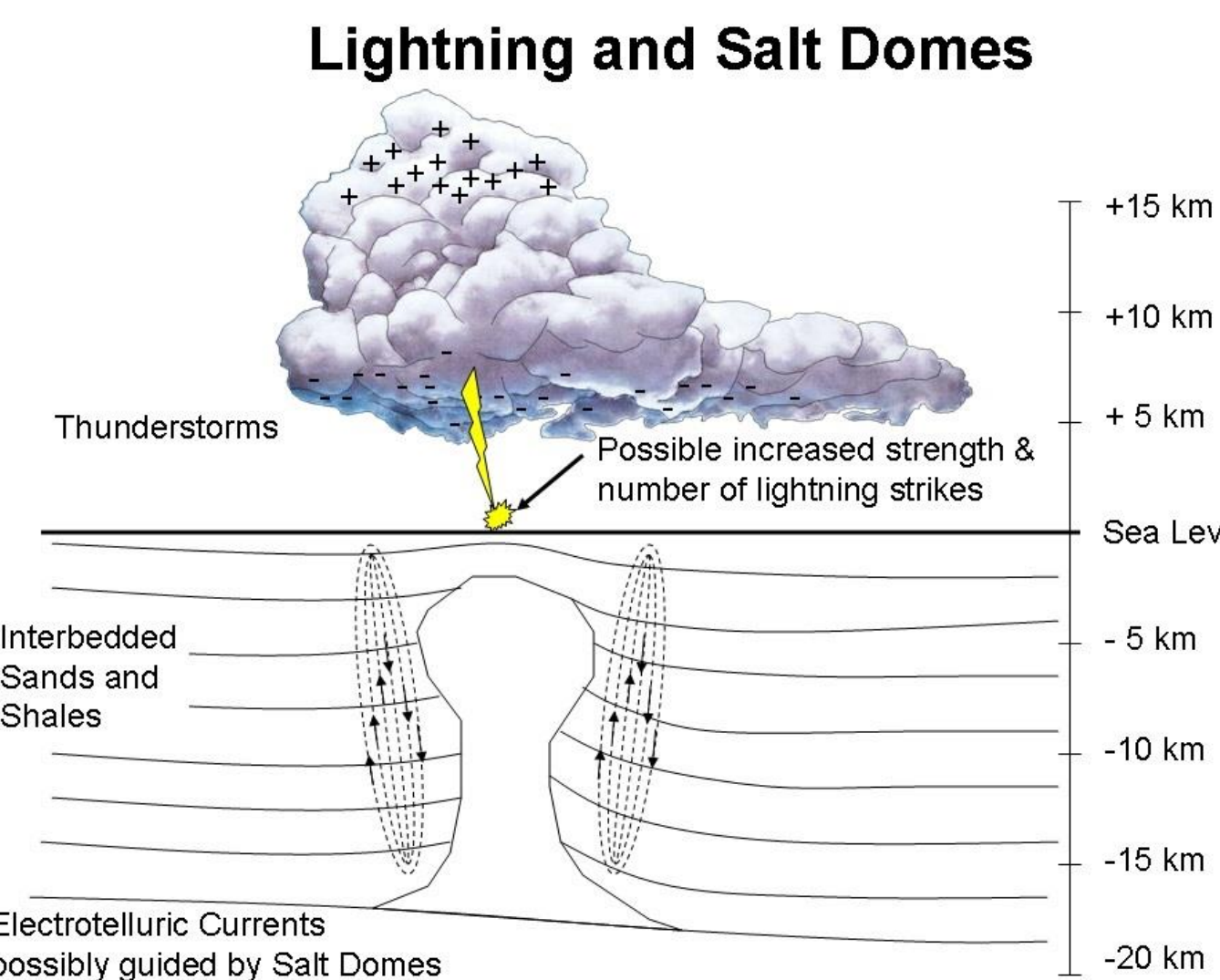
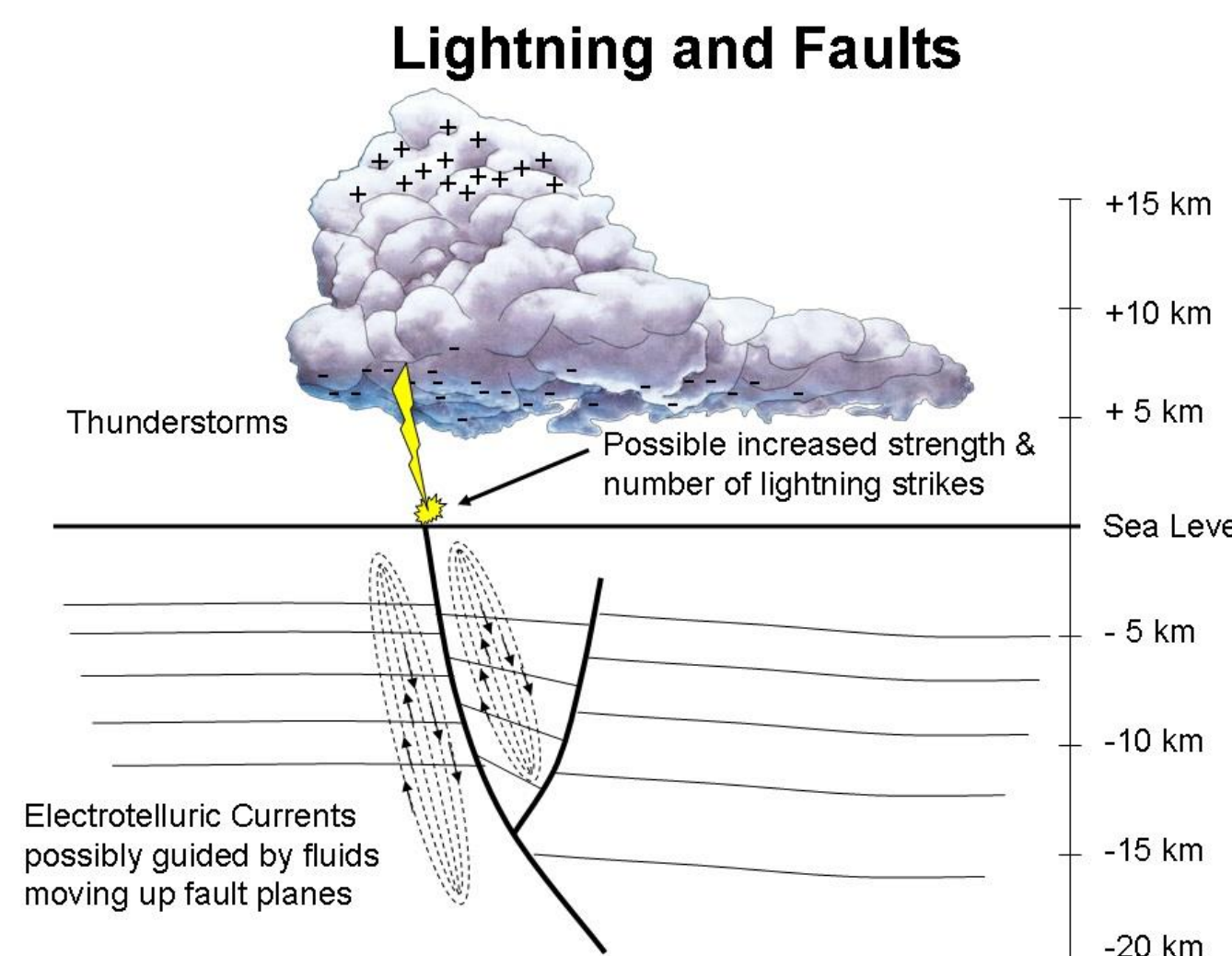
LIDAR Analysis Compares with Natural Source Electromagnetic Analysis or NSEM



Earth/Telluric Current

Run along faults, salt domes and other subsurface artifacts. Geomagnetic Hot Zones near the surface are more prone to Cloud-to-Ground Lightning Strikes.

The flow of these currents are modified by faults, mineralization, fluids like resistive fresh water or oil or gas or like conductive brines and geothermal waters, and by the conductivity or resistivity of lithology and geology like clays (conductive) and salt (resistive), etc.



Locations Not Random

A dozen lightning analyses show lightning strike locations are not random. From this work faults have been mapped, relationships have been made to sediment thickness, possibly we are predicting seeps, maps of anisotropy (fault density and orientation) have the potential to differentiate between ductile and brittle shales in significant new shale resource plays.

Fig. 1
US008344721B2

(12) United States Patent Nelson, Jr. et al.	(10) Patent No.: US 8,344,721 B2	(5) BLUE JETS
(45) Date of Patent: Jan. 1, 2013		

(54) METHOD FOR LOCATING SUB-SURFACE NATURAL RESOURCES

(51) Int. Cl. (2006.01)
G01V 31/02 (2006.01)
G01V 27/00 (2006.01)
G01V 1/00 (2006.01)

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(52) U.S. Cl. (2006.01)
324/71.1; 702/4

(58) Field of Classification Search
324/71.1; 702/4

See application file for complete search history.

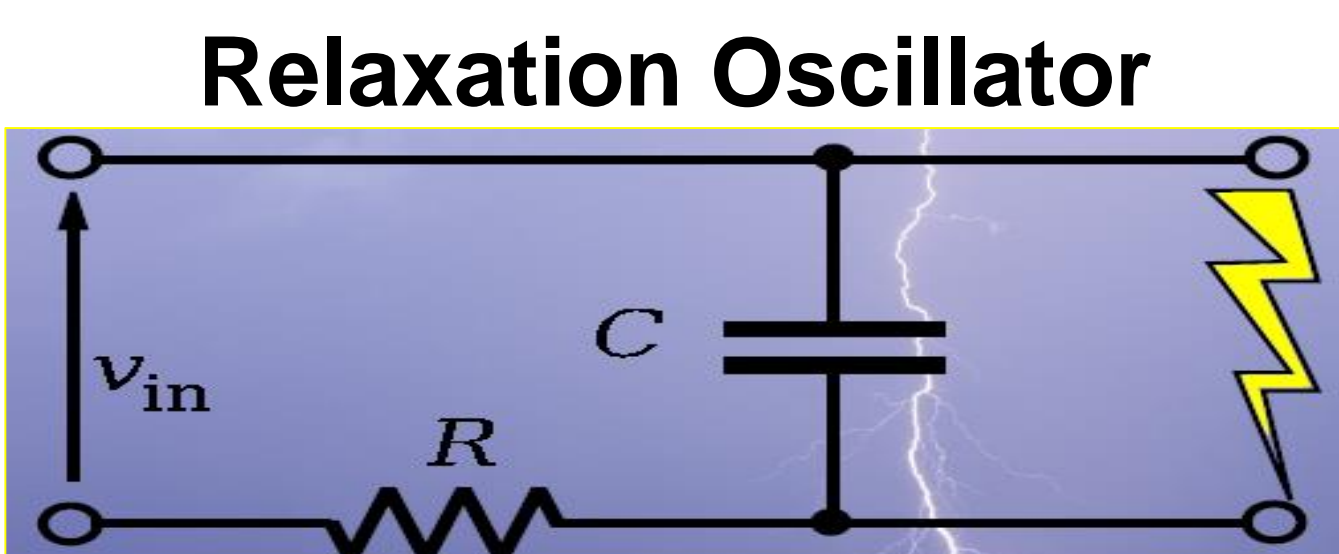
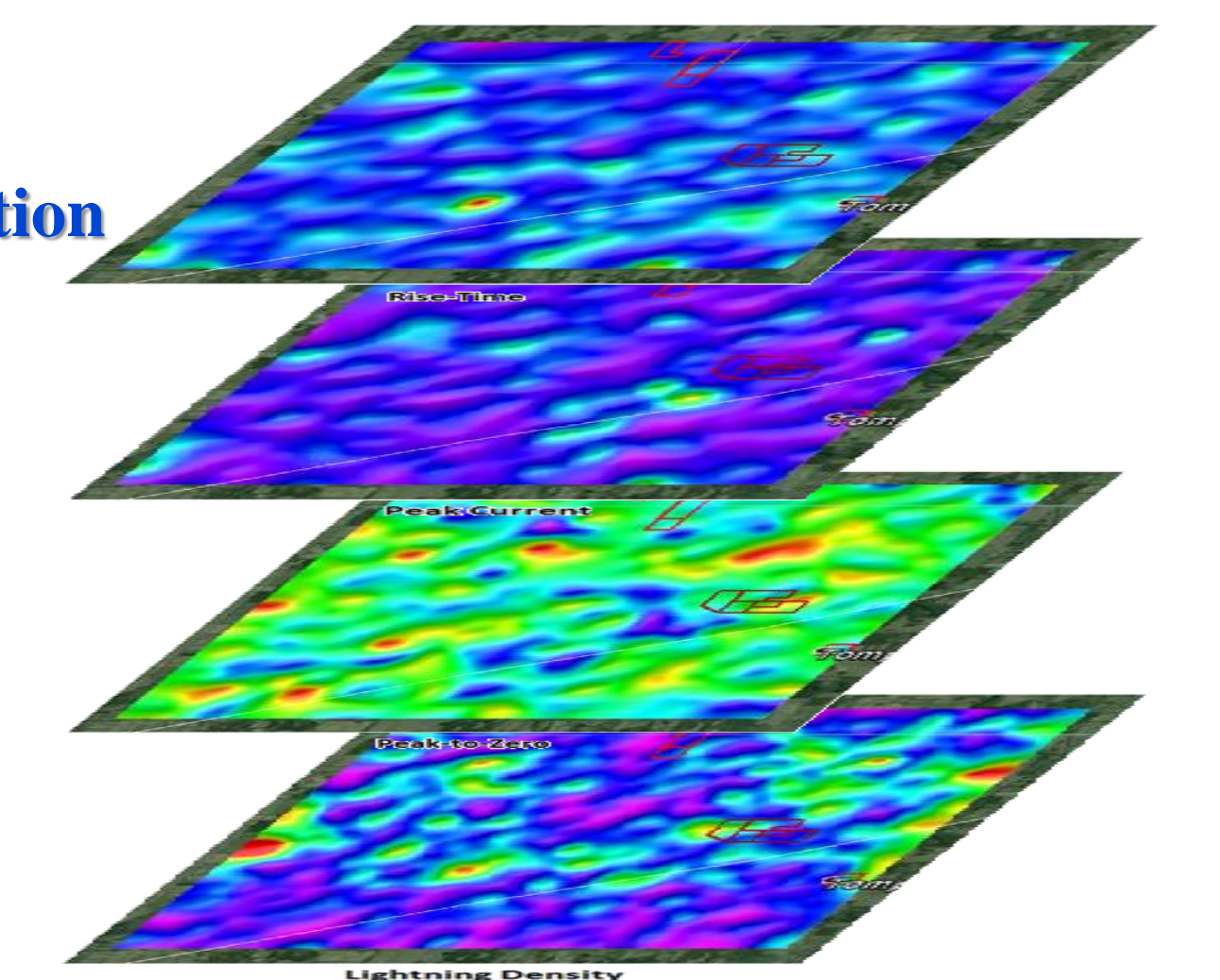
(56) References Cited
U.S. PATENT DOCUMENTS

U.S. Patent 8344721 B2: Jan. 2013; A method for locating sub-surface natural resources. The method utilizes lightning data to discern relatively likely locations for finding sub-surface natural resources.

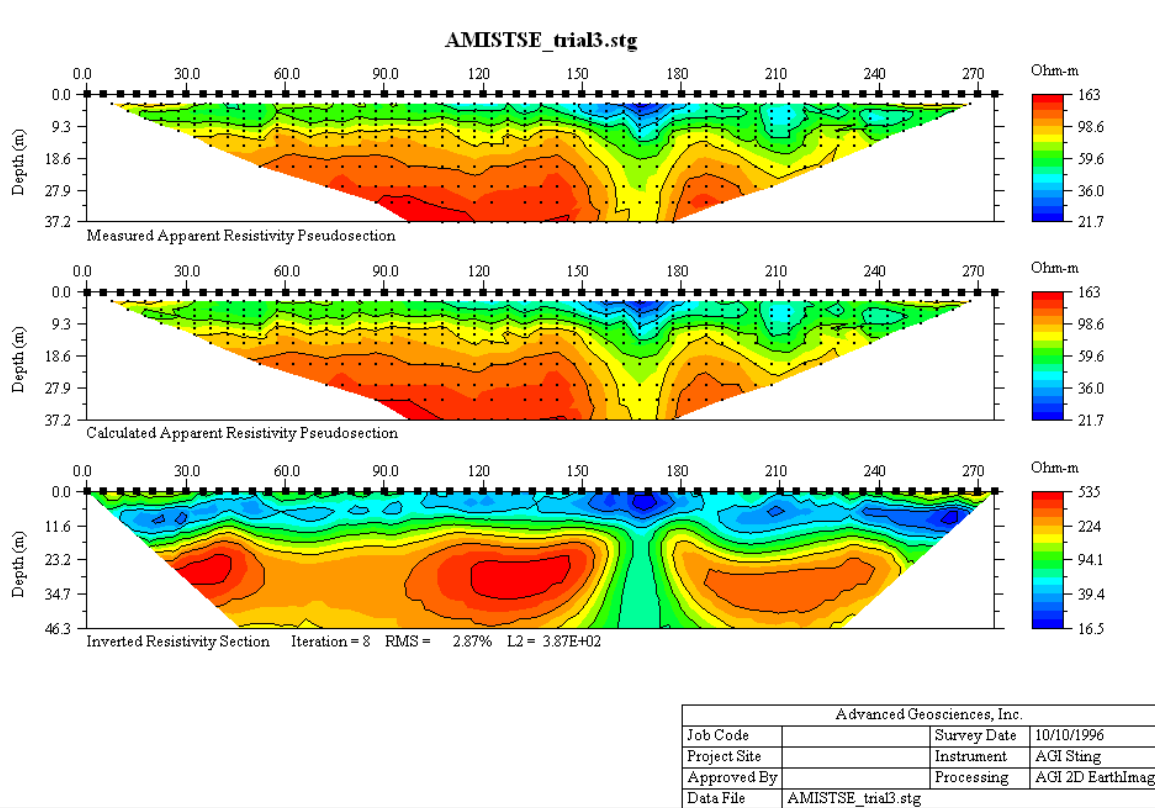
DML lightning studies have been published at geologic conferences nationally and internationally, as well as journals and magazines.

Conclusions

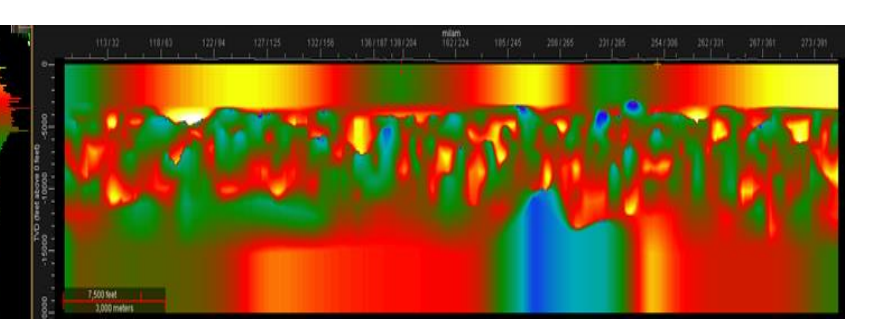
- Location
- Time and Duration
- Rise Time
- Peak Current
- Polarity
- Peak-to-Zero
- Density



Traditional Electromagnetic Survey vs Lightning Resistivity Analysis



The physics of lightning discharge are similar to the physics of a neon-tube relaxation oscillator. In each case, voltage builds across a capacitor until an insulating gas ionizes and becomes a conductor.



Lightning Based Resistivity Volume

NSEM and Resistivity Volumes are a Technology Breakthrough

