Defense Nuclear Nonproliferation Research & Development

Nuclear Explosion Monitoring Program Review
NEM2021

Geologic Framework Modeling (GFM) Integration

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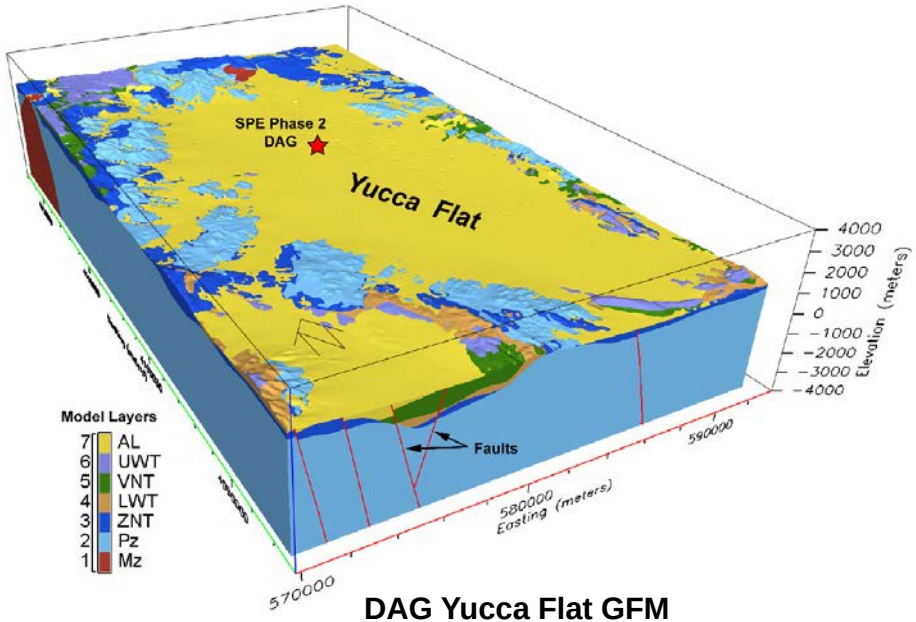
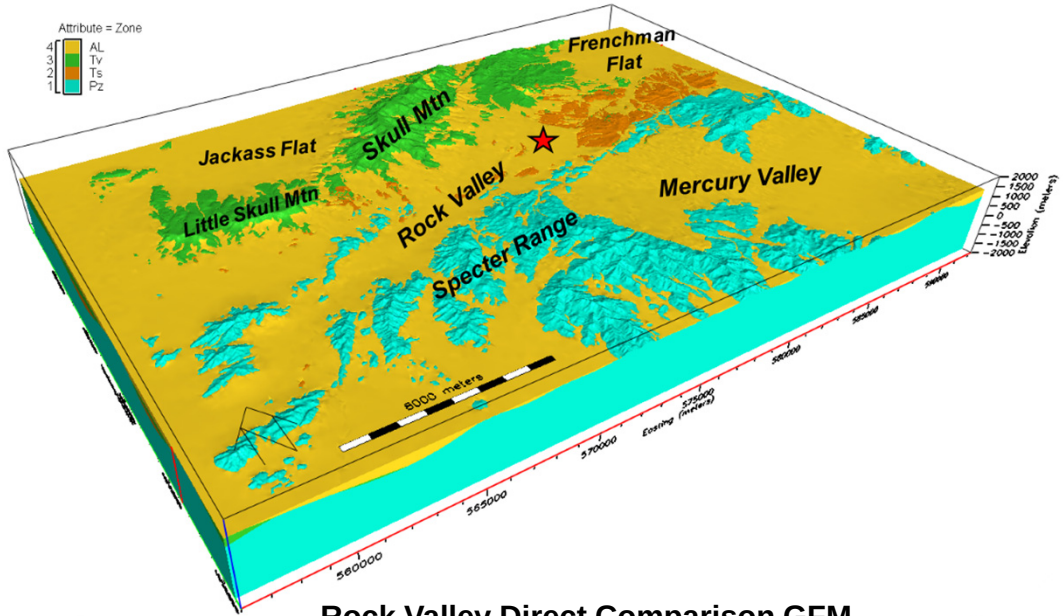
Geologic Framework Modeling (GFM) Integration

- **GFMs:**
  - **3-D representations of the geology of a region**
  - **Model the 3-D distribution of geologic features such as stratigraphic layers and faults**
  - **Provide a methodology for integrating geologic information and constraints into other models and simulations**



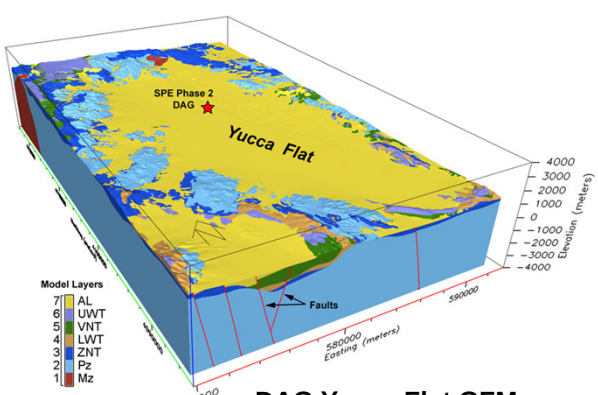
DAG Yucca Flat GFM



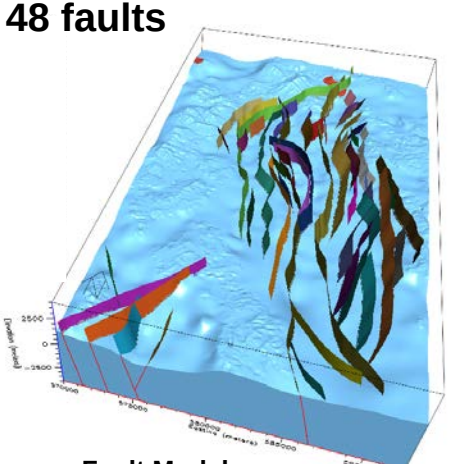
Rock Valley Direct Comparison GFM

Geologic Framework Modeling (GFM) Integration

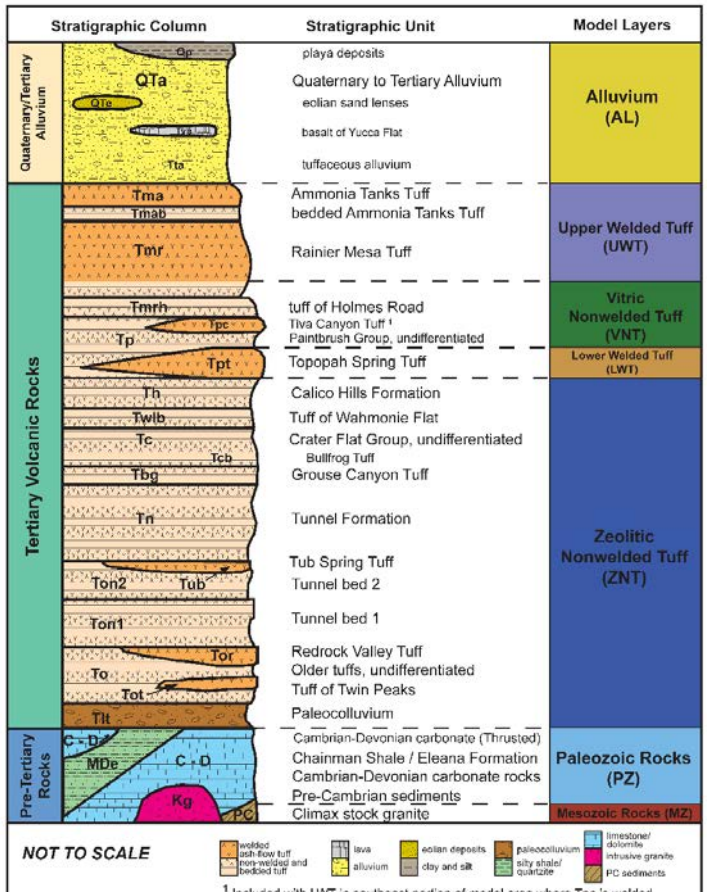
- **DAG Yucca Flat GFM**
  - **Dimensions:**
    - **22.5 x 39.0 km (878 km^2)**
    - **Extends from land surface to -4,000 m bsl**
  - **Input data:**
    - **Surface geology**
    - **956 drill holes**
    - **2-D seismic reflection**
    - **Gravity**
  - **Includes 7 stratigraphic layers and 48 faults**



DAG Yucca Flat GFM



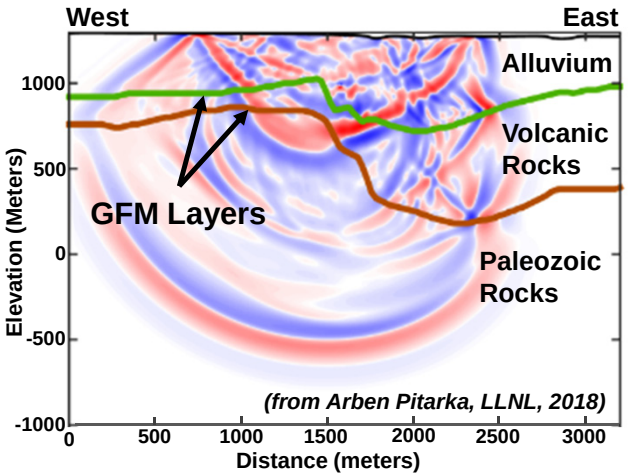
Fault Model



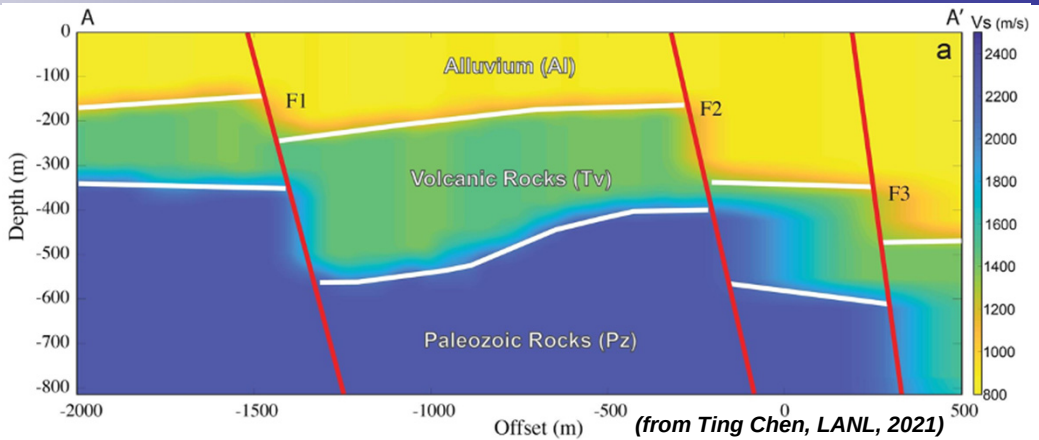
Stratigraphic Column for the DAG Yucca Flat GFM

Geologic Framework Modeling (GFM) Integration

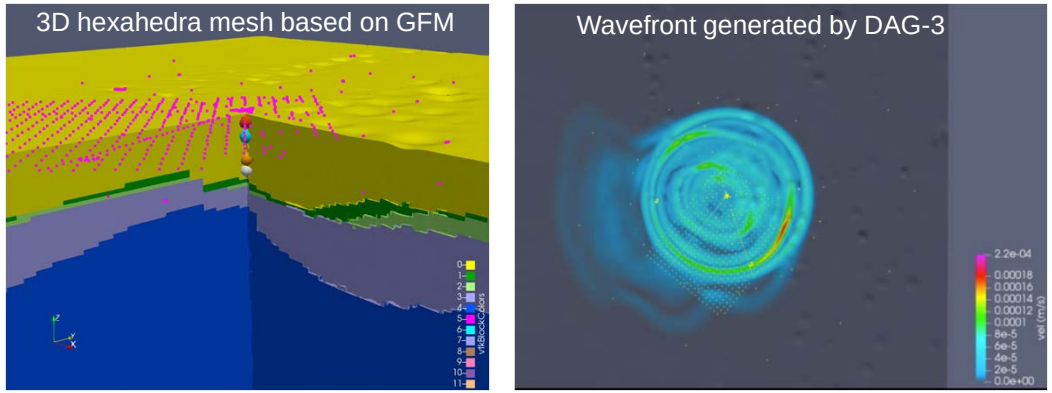
- **Examples of DAG GFM Integration**
  - **Pre-experiment simulations**
  - **Velocity model development**
  - **Wave propagation modeling**



DAG Pre-Experiment Wave Propagation Simulation (LLNL)



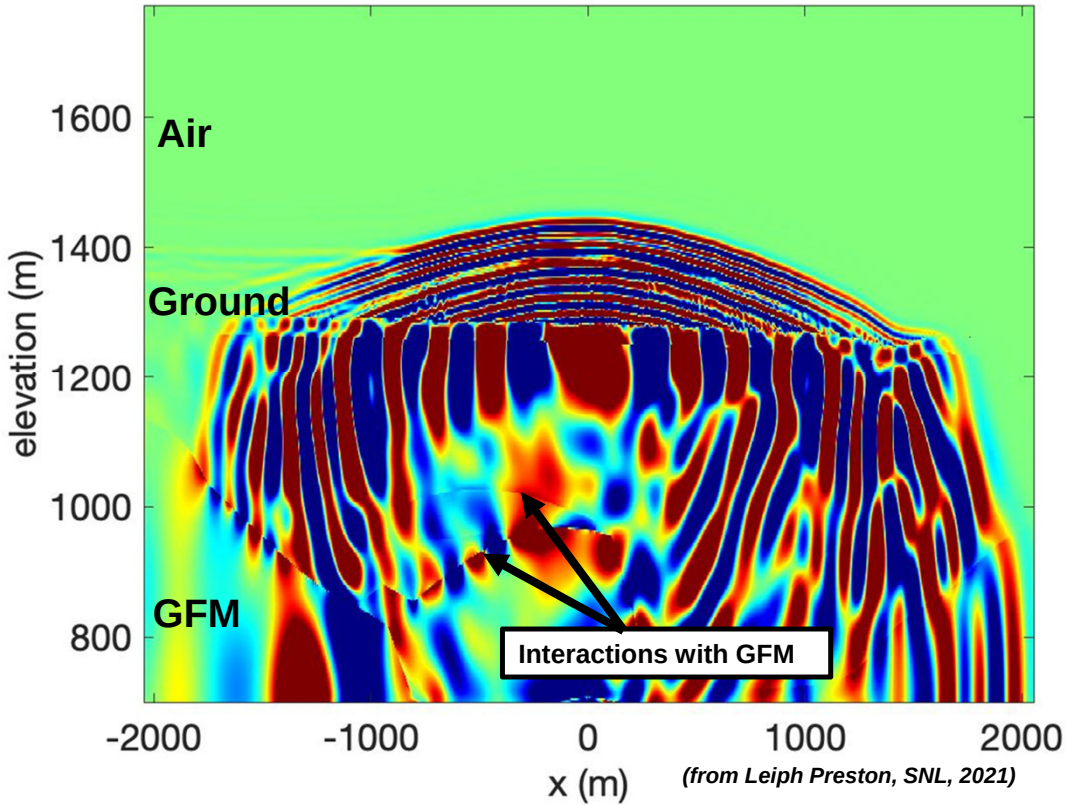
Comparison of Velocity Model with the DAG Yucca Flat GFM (LANL)



DAG-3 Wavefront Model (LANL)

Geologic Framework Modeling (GFM) Integration

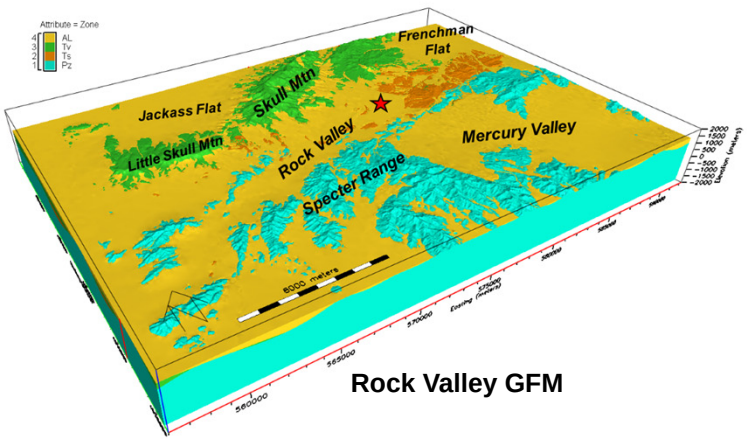
- **Examples of Integration (cont.)**
  - **Elastic-acoustic coupled simulations**



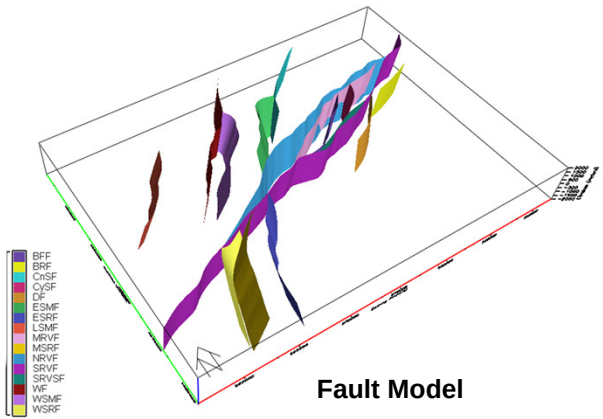
Snapshot of the Pressure Wavefield of an Elastic-Acoustic Coupled Simulation of DAG (SNL)

Geologic Framework Modeling (GFM) Integration

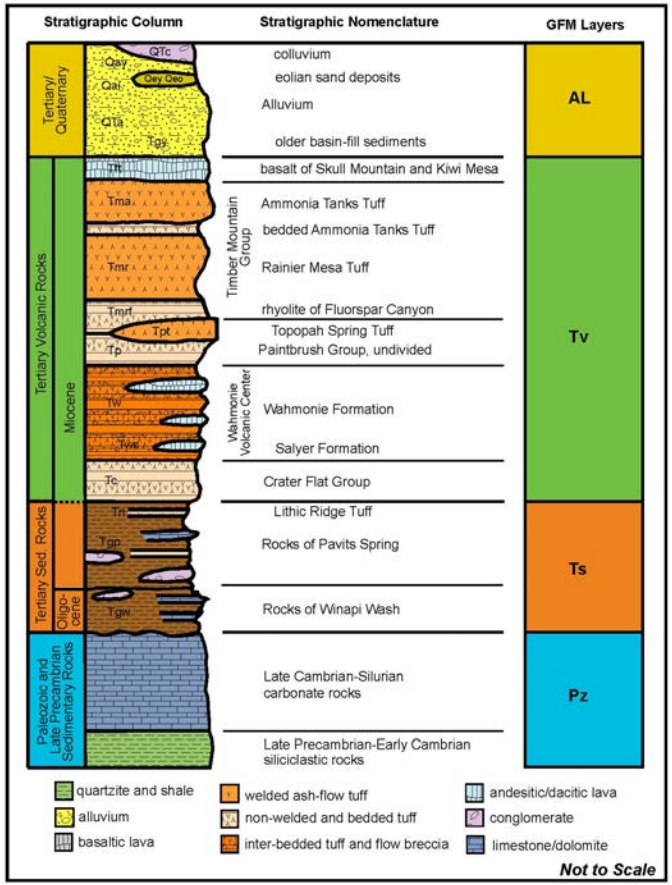
- **Rock Valley Direct Comparison GFM**
  - **Dimensions:**
    - **36.2 x 24.5 km (887 km^2)**
    - **Extends from land surface to -2,000 m bsl**
  - **Input data:**
    - **Surface geology**
    - **10 drill holes**
    - **Gravity**
  - **Includes 4 stratigraphic layers and 16 faults**



Rock Valley GFM



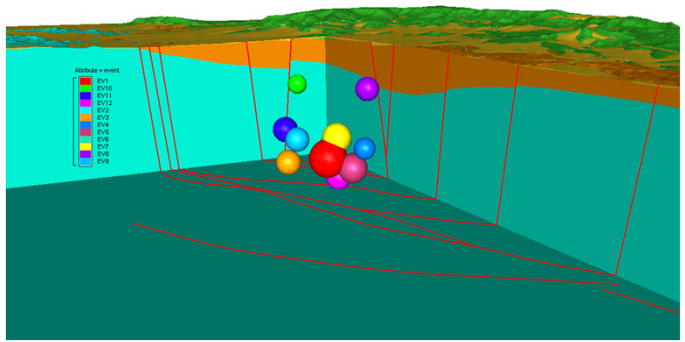
Fault Model



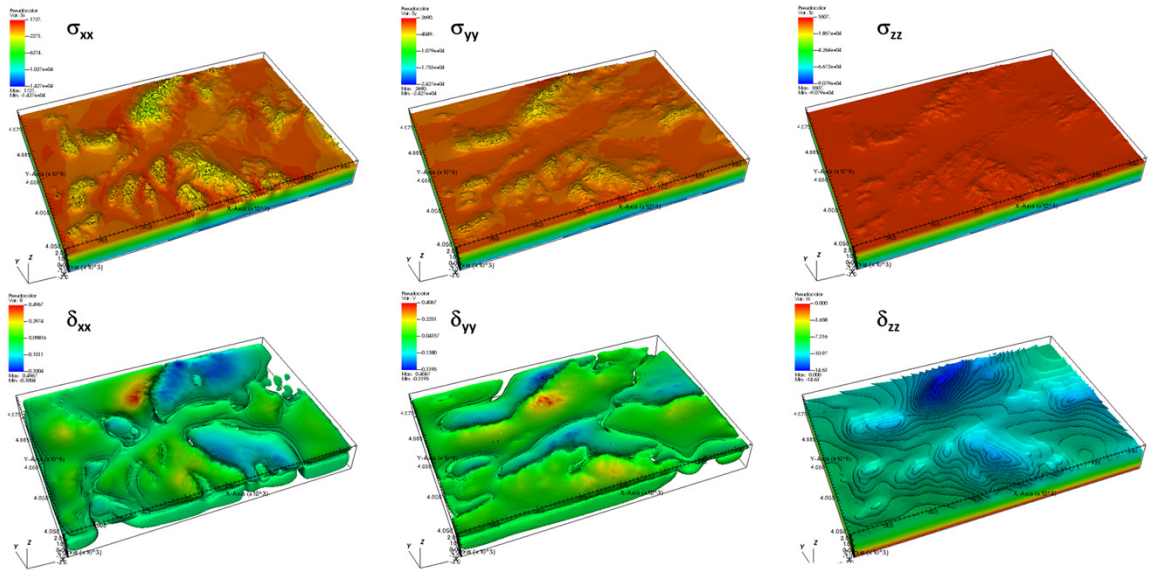
Stratigraphic Column for the Rock Valley GFM

Geologic Framework Modeling (GFM) Integration

- **Near-term Integration and Additional Work for the Rock Valley GFM**
  - **Simulations of Local Stresses**
  - **Incorporate information from planned geophysical surveys**
    - **Seismic reflection**
    - **Gravity**
  - **Build a more detailed near-field GFM**
    - **Rapid development of alternative geology scenarios**
    - **Drill hole planning**
    - **Earthquake relocation**



Chair Cut-Away View of the Rock Valley GFM Showing Locations of Earthquake Hypocenters



(from Souheil Ezzedine, LLNL, 2021)

Simulation of the State of Local Stresses in Rock Valley Using the GFM

Questions