Mudvolcanos in the Purcell basin and their relevance to Middle Proterozoic massive sulphide Ag-Pb-Zn deposits

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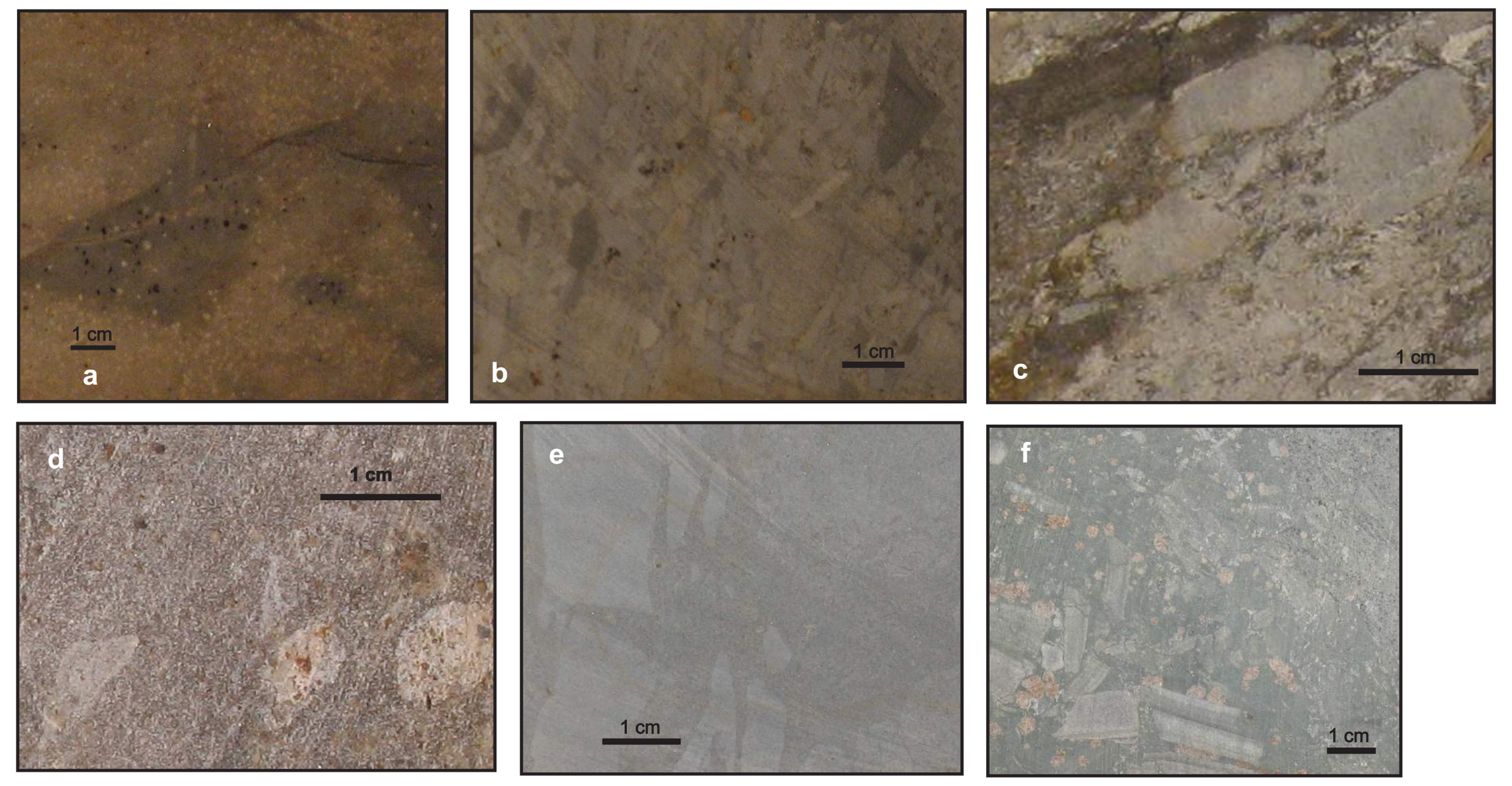
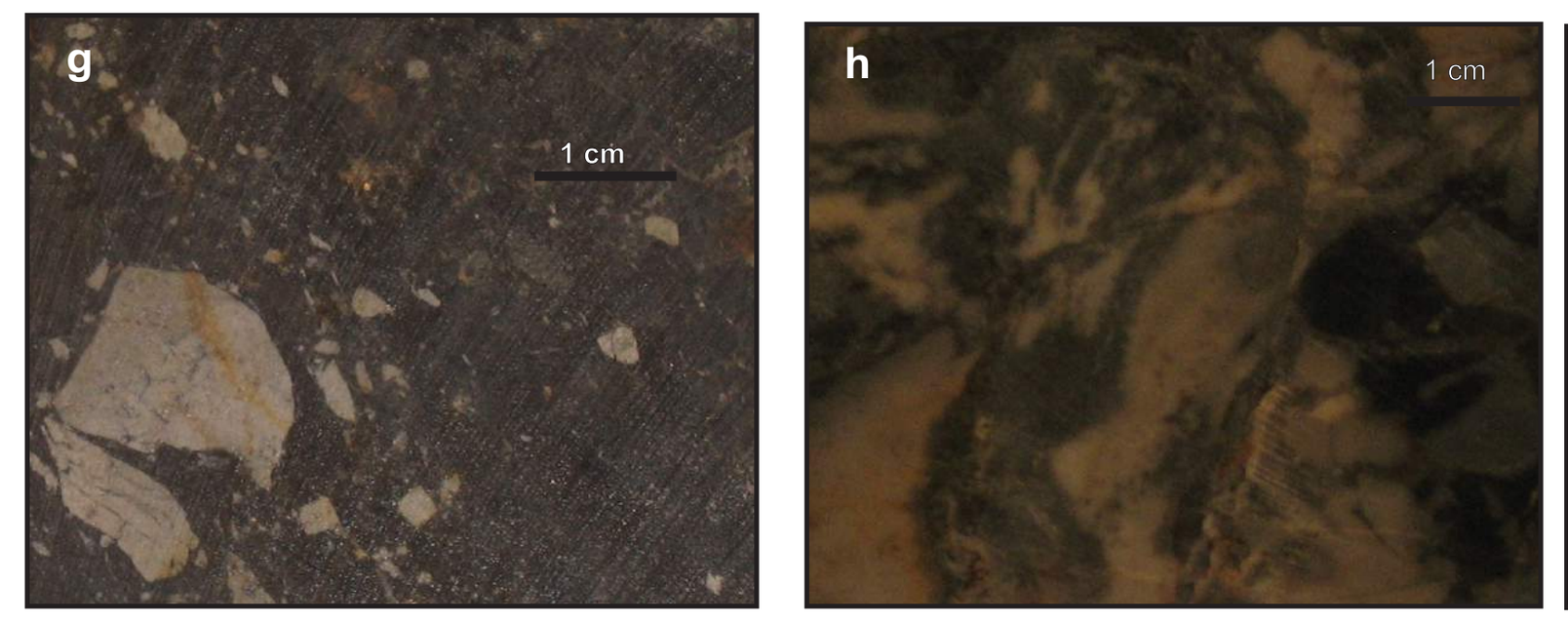
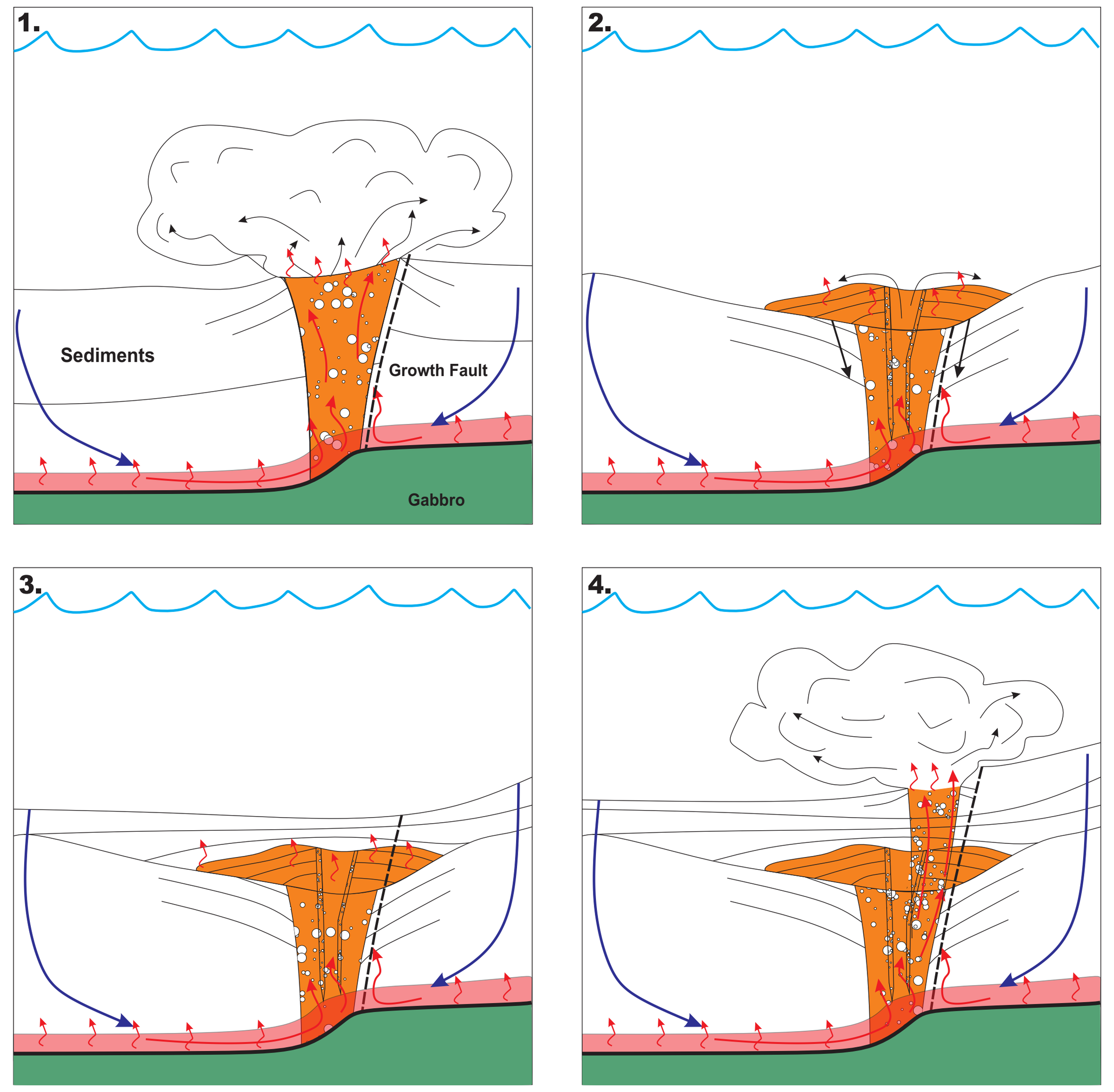
Fragmental Textures





a. Fragmental dyke; Rise
b. Fragmental mound; SBA
c. Fragmental mound; Vine West
d. Fragmental mound; Vine West
e. Fragmental dyke; Vine West
f. Fragmental dyke; SBA
g. Fragmental dyke; SBA
h. Fragmental dyke; Pakk

Schematic Model of Episodic Hydrothermal Venting and Mud Volcanism



1. Mafic sill injection into partially lithified wet sediments causes boiling and convection remobilizing sediments along a fluid escape structure which eventually erupts at surface forming a vent structure.
2. After eruption fluid escape structure remains 'open' focusing hydrothermal fluids in an upflow zone. Mud and sand volcanoes form while sediments collapse into the vent opening.
3. Vent system quiets and is covered during basinal sedimentation.
4. Renewed activity along growth faults begins process again.

Modified from Hoy 1993 and Jamtviet et al. 2004

Looking northwest towards the Jack Pipe and Mt. Evans in upper Jack Creek.

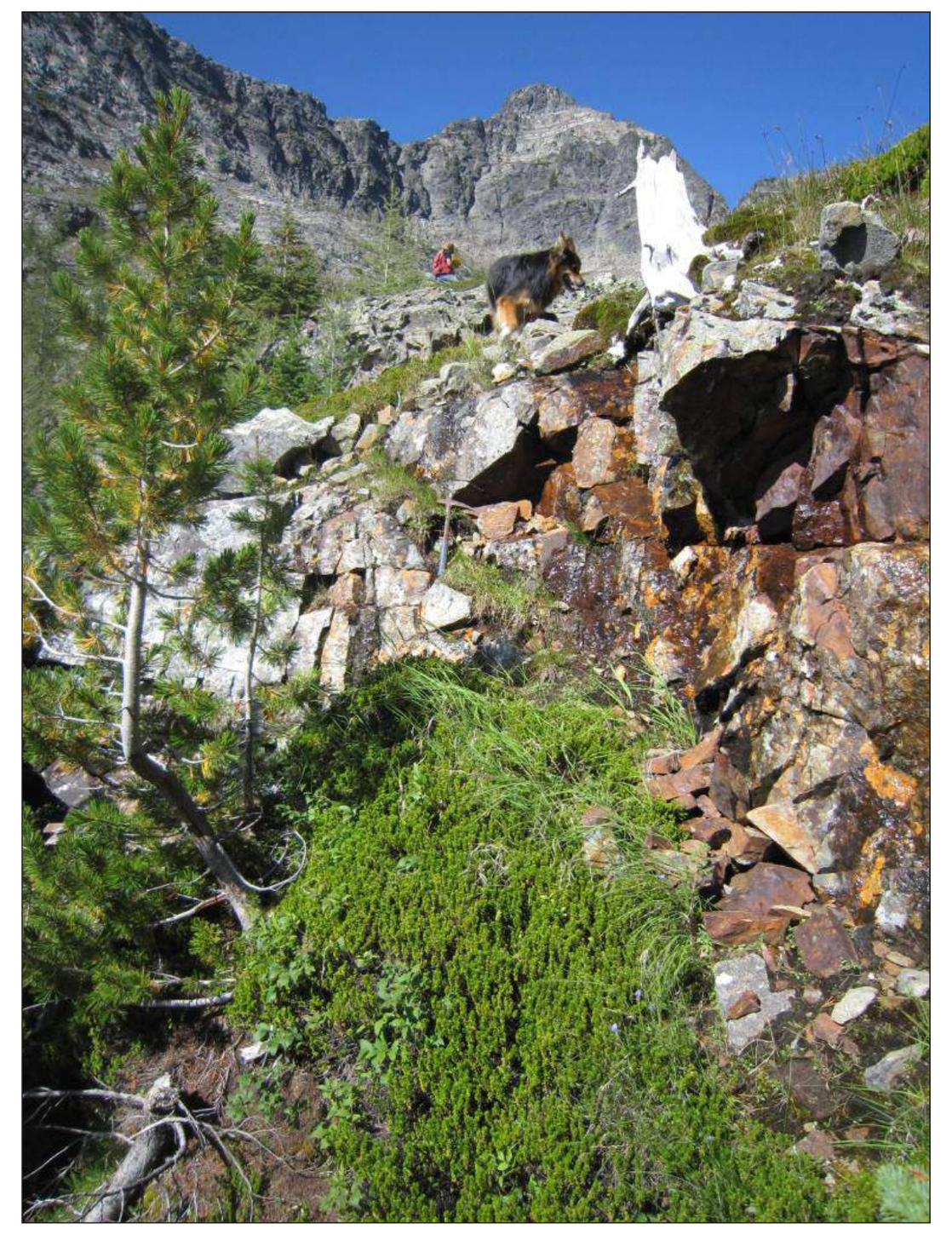
Polylithic clastic dyke-note black aphanitic tourmaline clasts.

Pakk

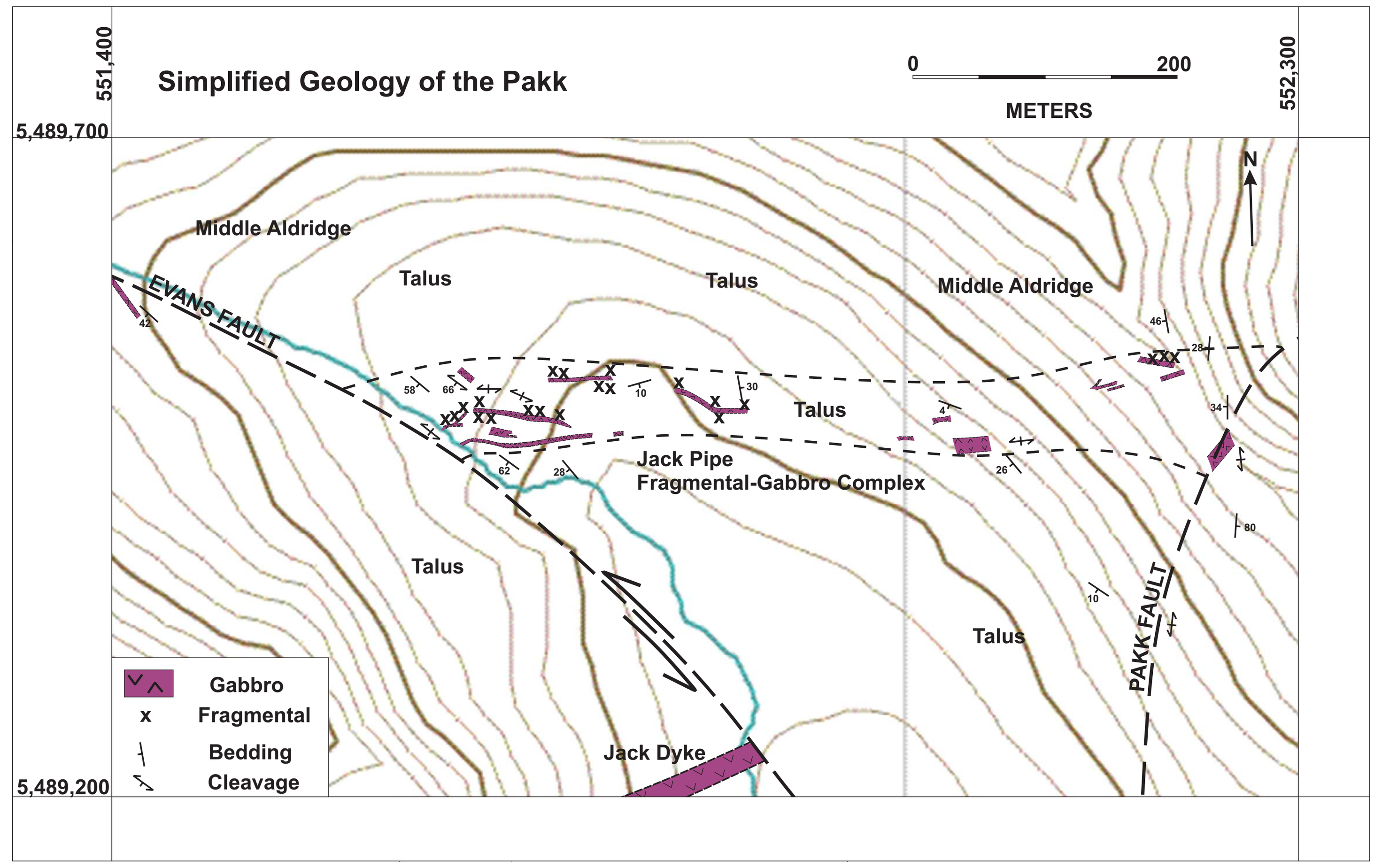
The Pakk prospect is located south of St. Mary Lake in the headwaters of Jack Creek. Here a cross-cutting fragmental dyke, referred to as the Jack Pipe, has intruded Middle Aldridge Fm sediments. The dyke forms an irregular east-west trending body that is bracketed to the east by the north-northeast trending Pakk Fault and offset to the west along the northwest trending Evans Fault. A later gabbroic dyke swarm has intruded the Jack Pipe showing sharp contacts with and locally hornfelsing fragmental rocks.

Mineralization consisting of massive sulphide, fracture, and disseminated galena, sphalerite, chalcopyrite, pyrhotite, and arsenopyrite is related to late-stage brecciation and alteration of both the fragmental and gabbro. Sulphide mineralization is commonly associated with albite, chlorite, biotite, actinolite, garnet, and silicification.

It is suggested that the Jack Pipe demonstrates a feeder/plumbing system that has had multiple events occur along it, including mud volanism, and later sulphide mineralization



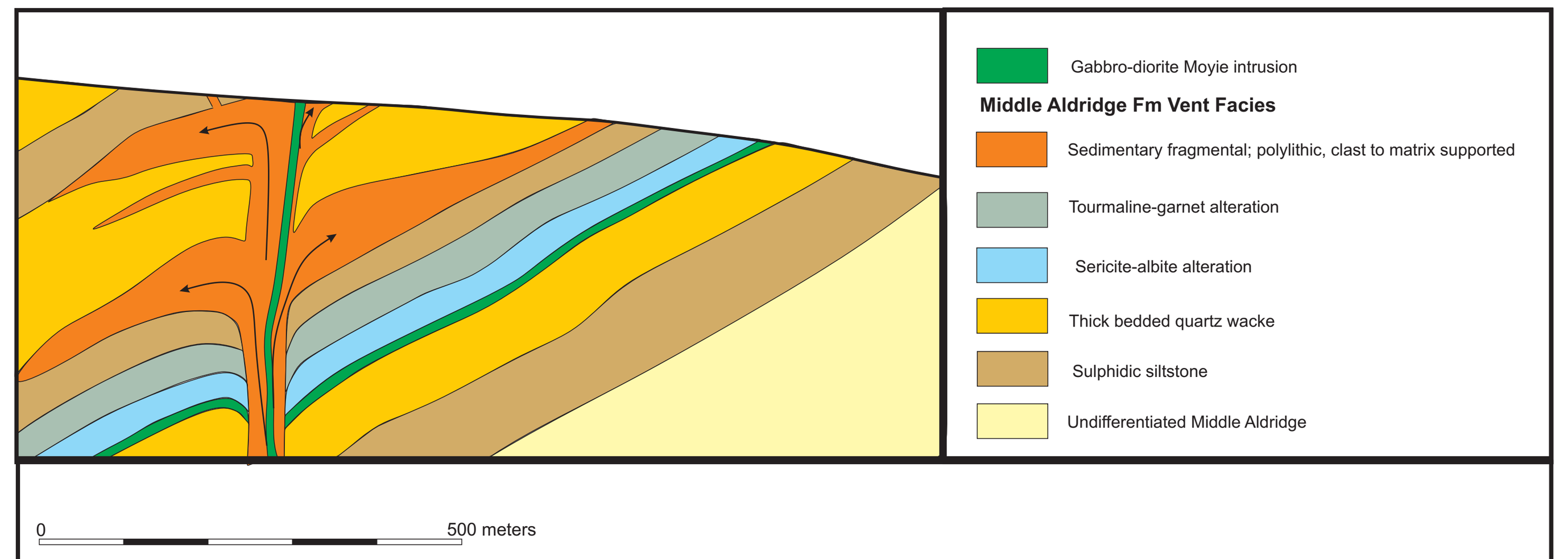
Looking northwest along the Jack Pipe.



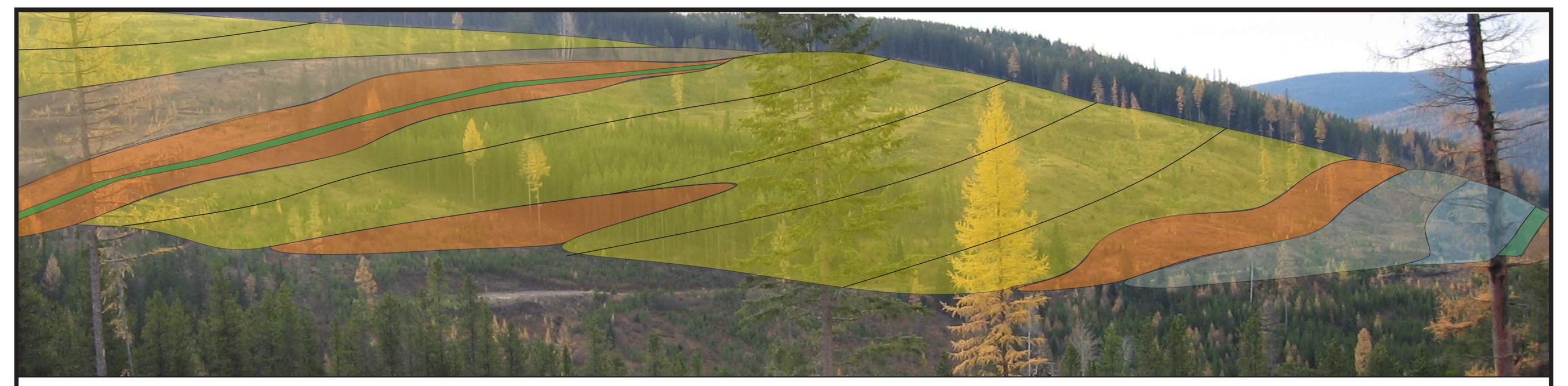
SBA Vent

The SBA Vent is located seven kilometers south of the village of Moyie. Here a number of polylithic clast to matrix supported fragmental mounds were extruded and deposited on the sea-floor during sedimentation.

Clastic feeder dykes underlie the mounds and are focuses for sulphide mineralization and associated alteration. Controlling structures are oriented north-south and northwest; two important Proterozoic age trends in the region.



Schematic cross section, looking southeast



Distribution of SBA vent facies, looking southeast

Looking south towards a clast dominated polylithic fragmental mound.

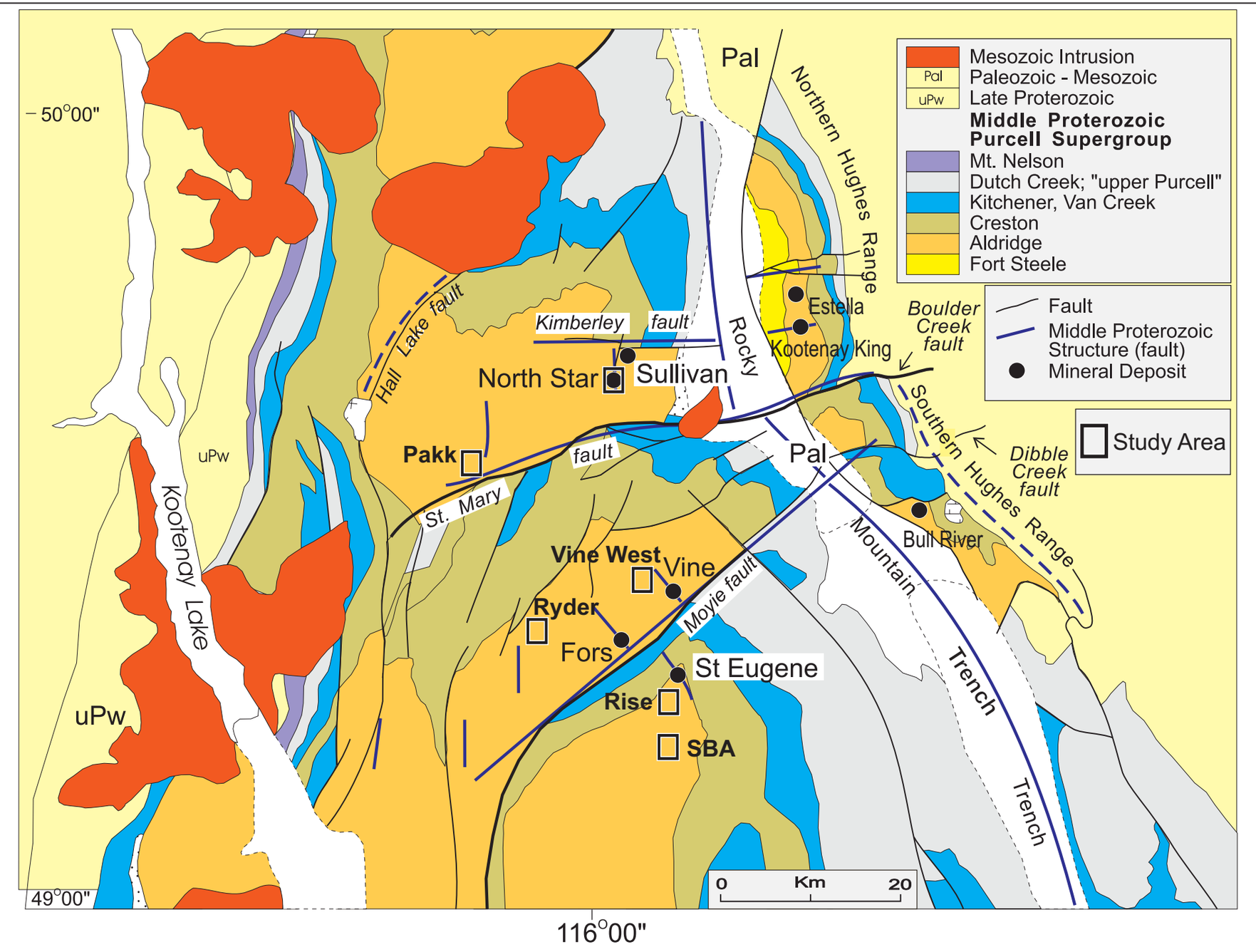
Bedded calc-silicate

Project Outline

Mud-volcanism is a unique feature within the rift-facies Aldridge Formation of the Purcell Basin. Massive sulphide Pb-Zn-Ag deposits in the Aldridge Formation are invariably related to these systems and many remain prime exploration candidates to host undiscovered deposits at various stratigraphic levels in the basin.

The project was undertaken with the intent to study a number of mud volcano complexes in order to identify key features associated with them. Geological mapping, rock geochemistry, and petrography were all to be used to help create a working database that could be employed by the exploration community to help guide future efforts in the Purcell basin.

Location map



Geological map of the Cranbrook Area showing major Middle Proterozoic structures, sulphide deposits, and 2014 study areass.

After Hoy et al., 2000.

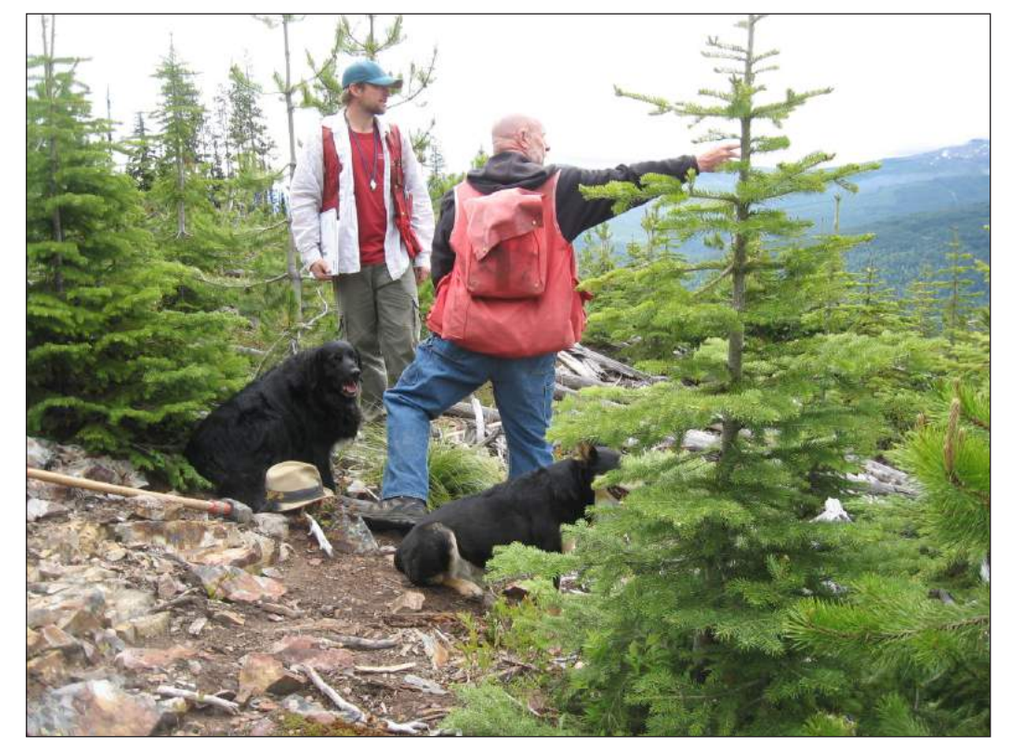
Results

Field work completed in the fall of 2014 included mapping and sampling of five mud volcano/fragmental complexes as well as sampling of a suite of rocks from the Sullivan corridor.

Currently rock samples are being analyzed for a standard 36 element ICP in order to create a comparative database. In addition petrographic work is being conducted on a suite of fragmental rocks.

Mapping has identified features consistent with each of the areas studied including; fragmental types, alteration assemblages, mineralization styles, and structural controls.

The final product, released in June 2015, will include schematic diagrams, assay data, and petroraphic work available for download from the Geoscience BC website.



Looking east on the Ryder Fragmental

Cross-cutting clastic dyke south of the village of Moyie. Sediments are shown tilting into the upflow zone.