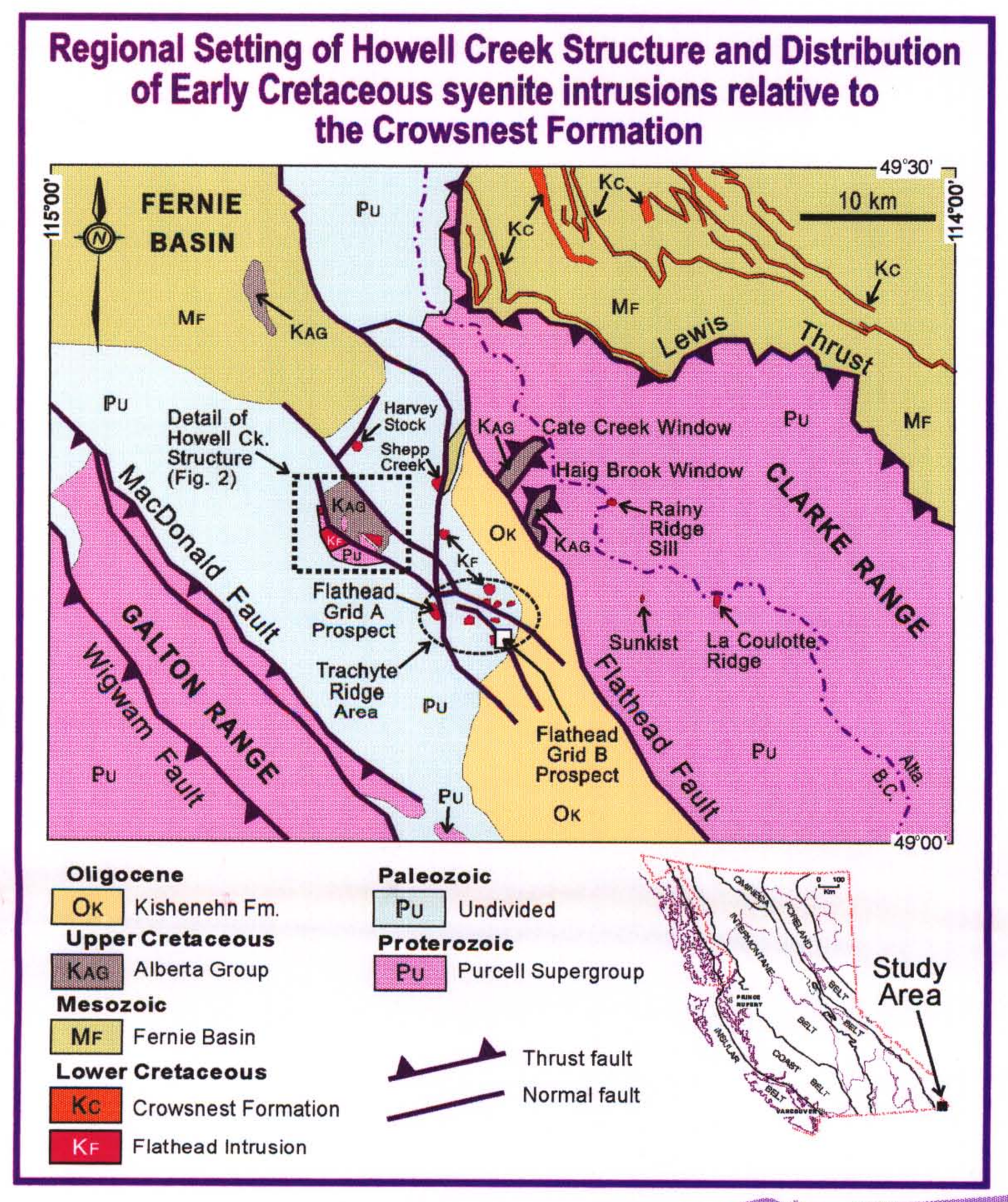
Howell Creek (82G/2,7)

Derek Brown and Rob Cameron

1. Fox Geological Services Inc.

Tom Schroeter (Crowsnest, Aug. 1999)



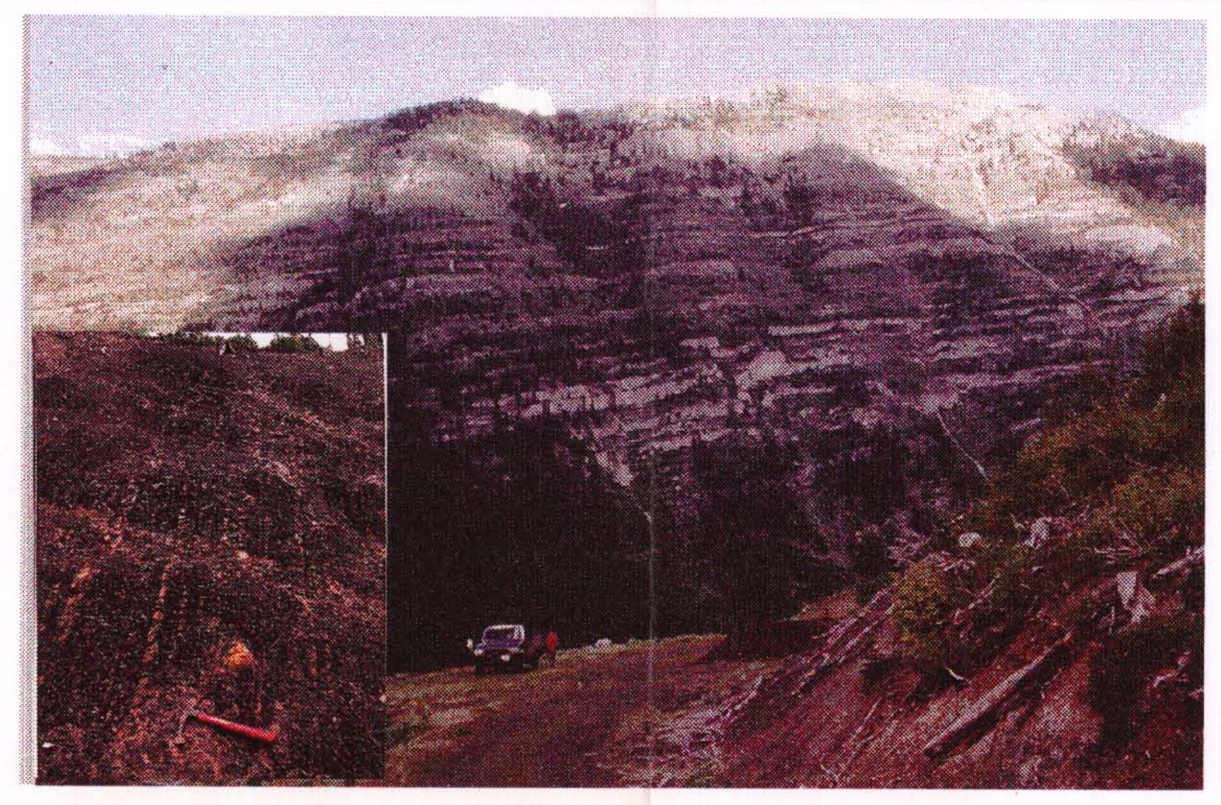
Introduction

Low grade, disseminated gold in sedimentary rocks and alkalic intrusions in the vicinity of the Howell Creek Structure of southeastern British Columbia were the focus of a two week field study by Brown and Spence. Much of the material presented here is based on results of numerous exploration programs undertaken by Cameron for Dome Exploration Canada, Limited, Placer Dome Inc. and Phelps Dodge Corporation of Canada, Limited.

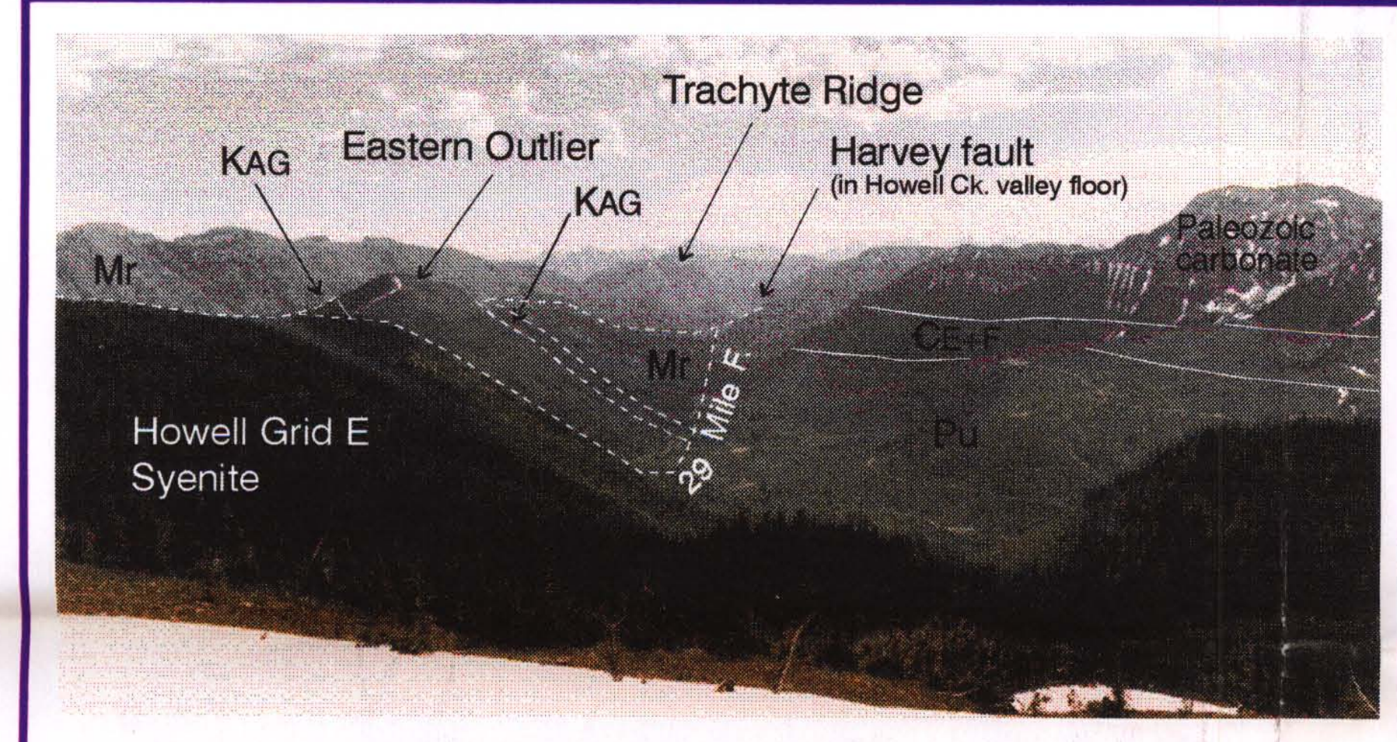
Regional Geological Setting

The geology of the Flathead area is characterized by Laramide structures, comprising thrust faults and open folds that have been modified by Tertiary normal faults. Strata exposed in the Flathead area include Proterozoic Purcell Supergroup clastics, Paleozoic carbonate and clastic rocks, Mesozoic clastic sequences and coal beds and Tertiary fault scarp units related to normal faults. Cretaceous alkalic intrusions comprising stocks, dikes and sills intrude layered rocks, but are almost wholly restricted to the area of Tertiary faulting.

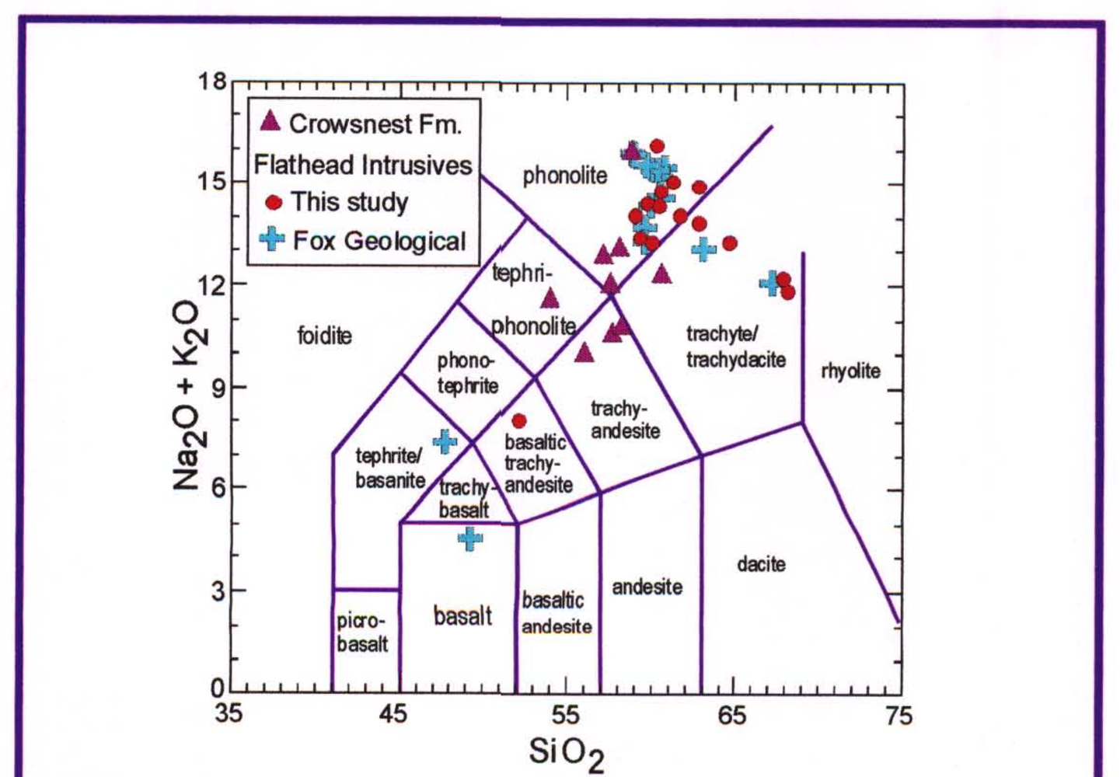
The gold occurrences lie within the HCS, an enigmatic feature located in a zone of northwest-trending normal faults. The HCS is a feature in which Upper Cretaceous marine sedimentary rocks of the Alberta Group occur within a fault-bounded window surrounded by Proterozoic to Mesozoic strata that have been intruded by bodies of Early Cretaceous syenite. The structural position of the Upper Cretaceous Alberta Group with respect to Lewis Thrust fault is the subject of many structural interpretations. The HCS is further complicated by the presence of 2 outliers of Proterozoic to Mesozoic rocks that structurally overlie the Alberta Group within the window.



View east to the sub-horizontal Mississippian Rundle Group on the northeast side of the Harvey Fault. Recessive Alberta Group shale and siltstone underlie the foreground within the Howell Creek Structure; the photograph illustrates the dramatic juxtaposition of these units. **Inset:** Typical Alberta Group, dark grey thin bedded siltstone exposure with prominent, widely-spaced limonitic concretions along a bedding plane.

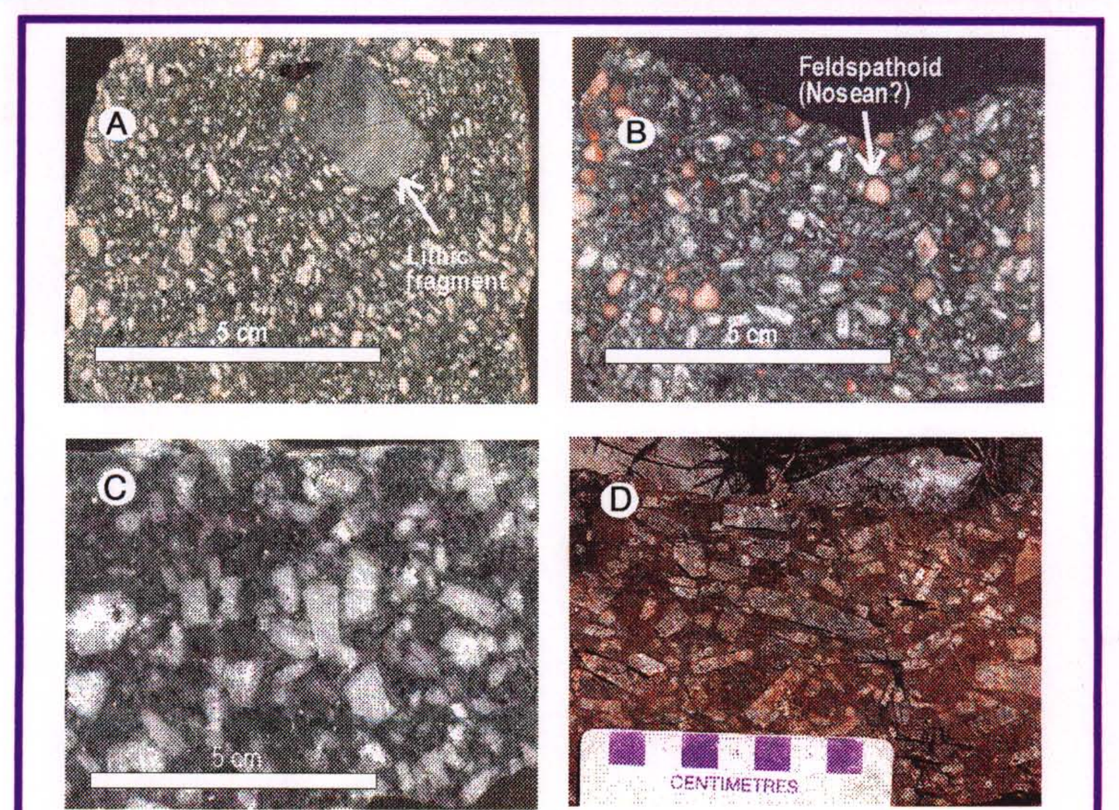


Overview looking east down Watluk and Twentynine Mile creeks to the southern portion of the Howell Creek Structure, the Eastern Outlier and Paleozoic carbonates to the south.



Total alkali vs. silica

Total alkali versus silica variation diagram (after LeBas *et al.*, 1986) displaying the alkaline character of the Flathead Intrusions and how they compare with Crowsnest Formation volcanic rocks (Crowsnest data from Peterson *et al.*, 1997).

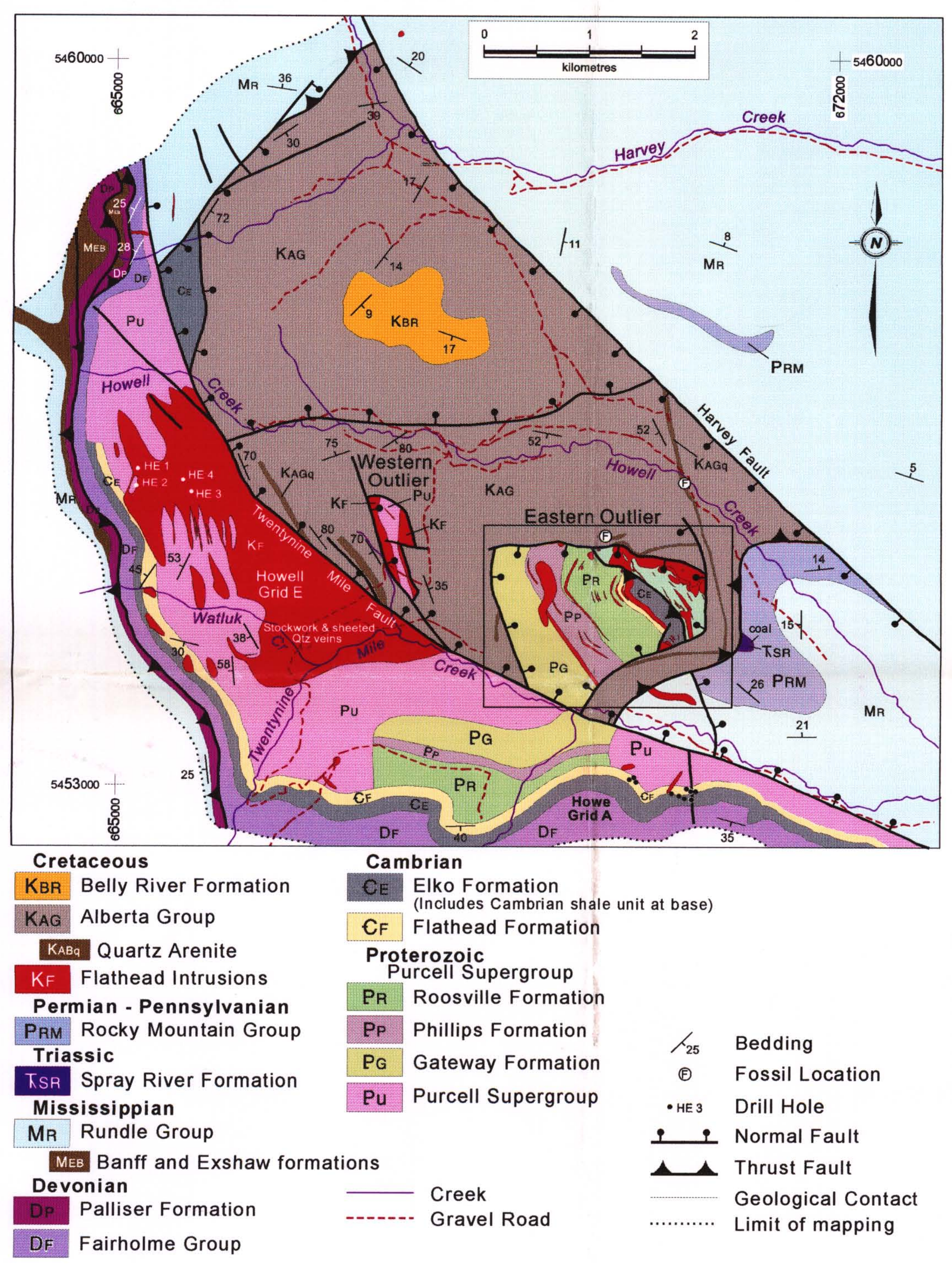


Syenite phases

Syenite phases in and adjacent to the Howell Creek Structure: (A) Foid syenite from the Eastern Outlier with angular mudstone lithic fragment; (B) Foid syenite from Eastern Outlier with equant, brown rimmed mineral (possibly nosean?). Fine dark specks are probably melanite garnet; (C) K-feldspar megacrystic syenite that cuts syenite on Howell Grid E; and (D) Tabular K-feldspar megacrystic syenite sill in the Eastern Outlier.

Geology of the Howell Creek Structure and adjacent area

(modified from Cameron *et al.* (unpub. Map), Legun (1993) and Price (1965))

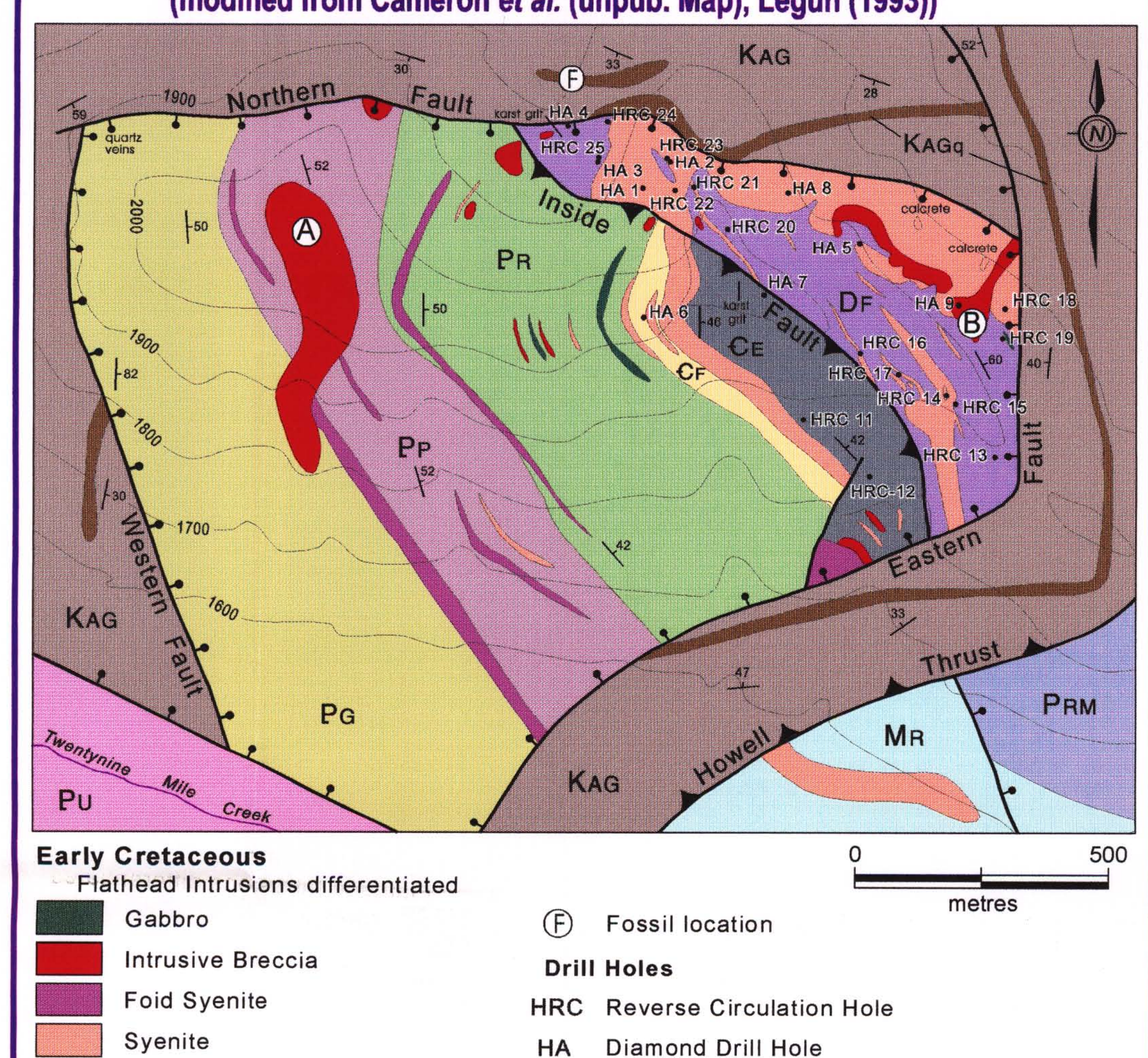


Eastern Outlier

Gold mineralization within the Eastern Outlier occurs in carbonate rocks exposed on the eastern end of the outlier. Here, various syenite and breccia bodies intrude limestone of the Elko and Fairholme formations. A prominent Au, As, Ag and Sb soil anomaly coincides with the extent of the carbonate rocks and guided early drilling. Drilling in reverse circulation drill hole HRC 25, returned a 58 m intersection grading 1.3 g/t Au from pyritic silicified limestone.

Detailed geology of the Eastern Outlier -- illustrating syenite and breccia distribution

(modified from Cameron *et al.* (unpub. Map), Legun (1993))



Mineralization

Central Zone: large syenite plugs and intrusive breccias

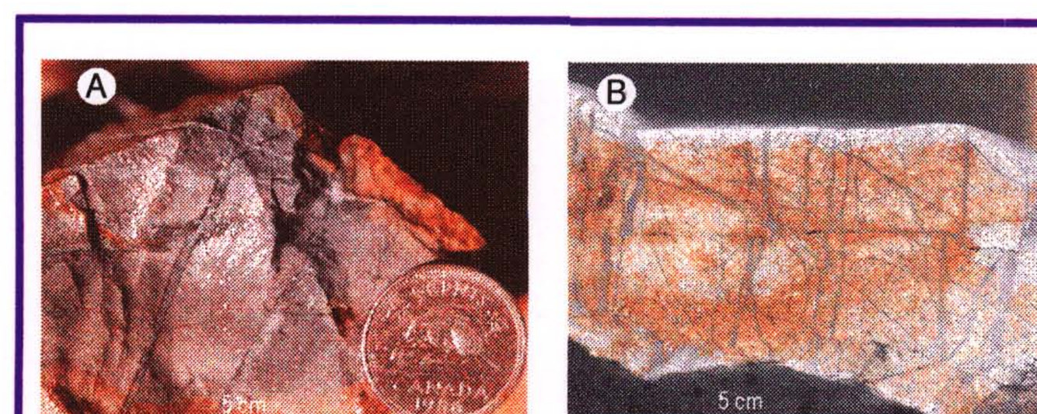
- central porphyry Mo-like system- quartz stockwork in Howell Grid E;
- intense silicification of siliciclastic rocks, disseminated and vein fluorite common, extensive intrusive breccia development, local galena, sphalerite, chalcopyrite;
- extensive pyritization.

Peripheral Zone: small syenite bodies, foid syenite sills, intrusive breccias

- multiple generations and varieties of intrusive bodies;
- alteration dominated by carbonatization of intrusives, pyritization, moderate to weak silicification, argillization;
- widespread low-grade gold in limestone and intrusive.

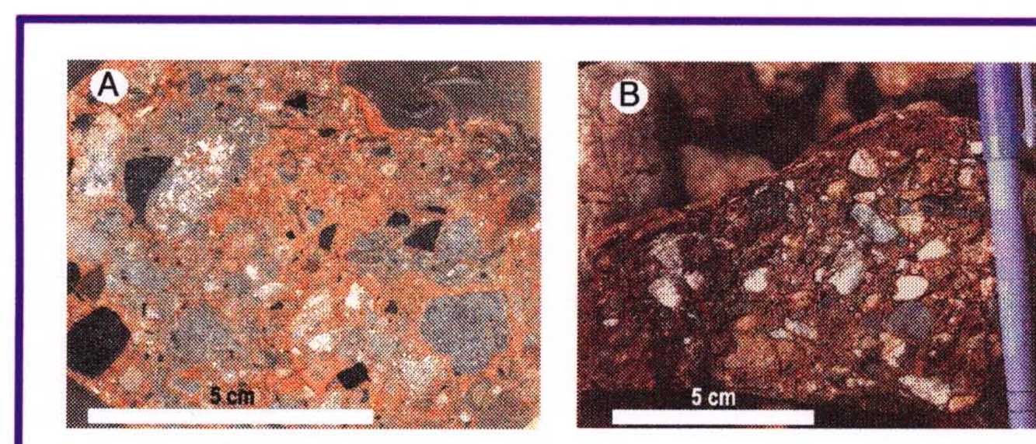
Distal Zone: isolated small dikes, syenite and foid syenite (i.e. Howe Grid A)

- isolated and volumetrically minor dikes of syenite and foid syenite;
- minor pyritization, rare barite veining, disseminated gold in sandstone and siltstone and green shale;
- manto-style base metal mineralization- colloform sphalerite in limestone, fluorite and pyrobitumin in limestone.



Mineralization

Examples of mineralized and altered rocks: (A) narrow quartz veinlets with partially silicified envelopes and very finely disseminated pyrite hosted in limestone; (B) Quartz stockwork developed in argillic-altered syenite offset by late fractures from Howell Grid E.



Breccia types

Examples of breccia types in Breccia B of the Eastern Outlier: (A) heterolithic intrusive breccia with angular, matrix-supported limestone and syenite fragments; (B) Discordant, limonitic weathering heterolithic breccia containing subangular limestone and lesser syenite fragments. Partially recessive matrix is carbonate-rich.

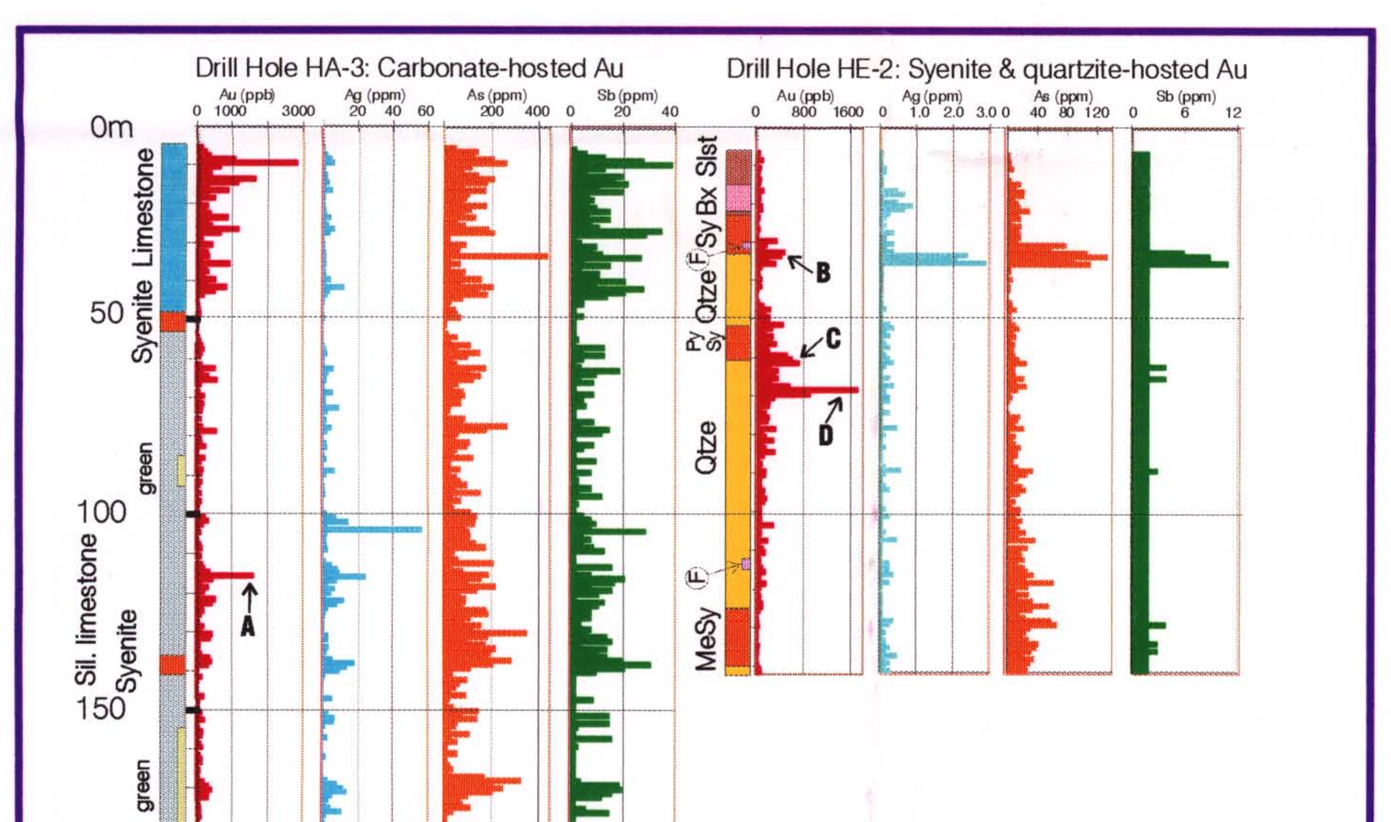
PIMA Results *(conducted by Anne Thompson and Audrey Robitaille)*

- alteration mineralogy includes illite, calcite, smectite, chlorite and gypsum
- SEM - EDS shows NO chromium in illite
- TO DO: integrate these results with the deposit geology

Element abundances and correlation matrix for carbonate-hosted gold: Drill hole HA-3

	ppb	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	%	%	
	Au	***Ag***	***As***	***Sb***	***Ba***	***V***	***W***	***Mo***	***Cu***	***Pb***	***Zn***	***Fe***	***Ca***	***Al***	***Ag/Au***
Mean	247	3.38	100.22	8.20	54.76	12.30	1.18	1.97	15.98	17.86	45.72	0.91	25.05	0.21	22.50
Median	153	1.50	85.00	5.00	39.00	11.00	1.00	1.00	12.00	14.00	42.00	0.90	25.49	0.12	7.41
Mode	340	0.10	29.00	2.00	13.00	8.00	1.00	1.00	9.00	11.00	42.00	0.89	27.69	0.06	12.50
Std. Dev.	327	6.70	72.27	7.44	65.85	8.25	0.82	3.62	14.83	11.36	25.72	0.46	7.74	0.26	70.89
Minimum	6	0.10	5.00	2.00	8.00	3.00	1.00	1.00	1.00	2.00	8.00	0.09	1.11	0.02	0.78
Maximum	2820	56.30	437.00	39.00	565.00	104.00	10.00	42.00	96.00	57.00	139.00	3.26	39.13	1.41	738.36
Count	181	181.00	181.00	181.00	181.00	181.00	181.00	181.00	181.00	181.00	181.00	181.00	181.00	181.00	181.00

	Au	*Ag*	*As*	*Sb*	*Ba*	*V*	*W*	*Mo*	*Cu*	*Pb*	*Zn*	*Fe*	*Ca*	*Al*
Au	1.00													
Ag	0.18	1.00												
As	**0.49**	0.19	1.00											
Sb	**0.71**	**0.37**	**0.77**	1.00										
Ba	0.02	-0.05	-0.07	-0.06	1.00									
V	**0.27**	**0.29**	0.10	0.11	0.02	1.00								
W	**0.46**	0.03	0.17	**0.29**	-0.01	0.09	1.00							
Mo	-0.06	**0.53**	-0.02	-0.06	0.03	0.14	0.01	1.00						
Cu	0.18	**0.52**	0.18	**0.23**	-0.02	**0.44**	0.09	0.21	1.00					
Pb	**0.28**	0.18	**0.47**	**0.42**	-0.05	0.04	0.18	0.01	0.10	1.00				
Zn	0.06	0.02	**0.32**	0.20	0.09	0.08	0.08	0.04	0.03	**0.52**	1.00			
Fe	0.08	**0.24**	**0.55**	**0.37**	-0.10	**0.24**	0.19	0.21	**0.28**	**0.46**	**0.47**	1.00		
Ca	0.11	-0.20	-0.06	0.02	0.07	-0.17	-0.12	-0.17	-0.16	**-0.45**	**-0.35**	**-0.51**	1.00	
Al	**-0.25**	0.07	**-0.37**	-0.37	0.12	**0.26**	0.04	**0.50**	0.12	-0.10	0.17	0.19	**-0.37**	1.00



Downhole geochemistry

Comparison of downhole variations of Au, Ag, As and Sb values relative to lithology for a diamond drill hole from the Eastern Outlier (HA-3) and Howell Grid E (HE-2). One metre sample interval. The higher concentrations of As and Sb in carbonate units is clearly apparent. Lithologic detail for some of the anomalous gold intervals: (A) pyritic-clay gouge; (B) pyritized contact between syenite and quartzite and lesser crackle breccia; (C) bleached, clay-altered syenite adjacent to quartzite; (D) fluorite- and pyrite-rich quartzite. Abbreviations: Bx = breccia, F = fluorite, MeSy = megacrystic syenite, Sil = silicified, Slst = siltstone; Py = pyritic, Qtze = quartzite; Sy = syenite.

Microprobe Results *(from Bart Cannon)*

Pyritic limestone samples

- **pyrite:** contains < a few tenths As (no zoning); euhedral, and filamentous; rare sph and gal inclusions
- **galena:** occasional 50 micron grains in quartz
- **tennantite:** silver free
- **anatase:** common
- **apatite:** 30 microns, common

Sulphide veins cutting syenite sill

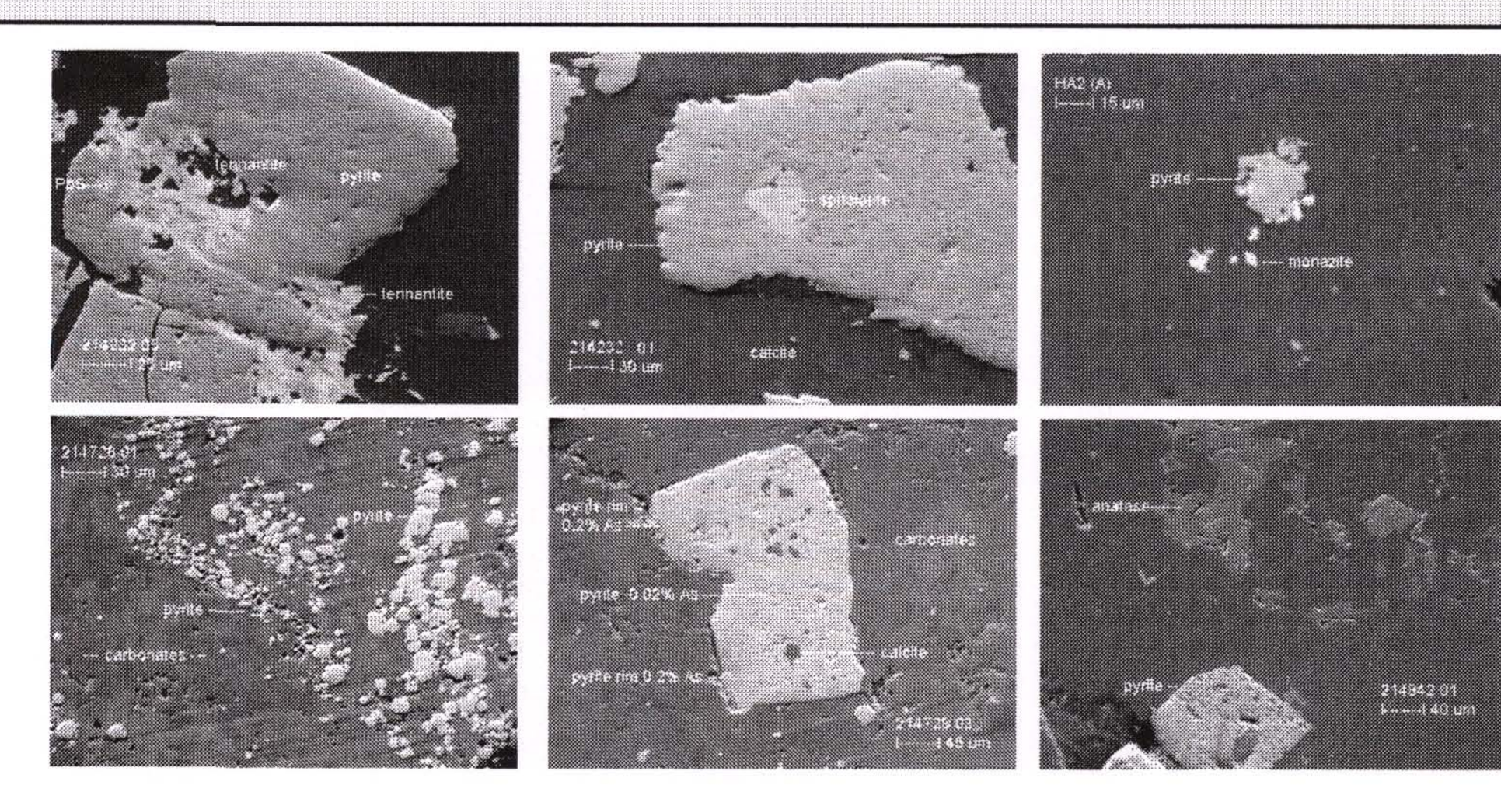
- **pyrite:** contains trace As (enriched edges of crystals));
- **anatase:** common and coarse

Pyritic intrusive breccia

- **pyrite:** contains < a few tenths As (no zoning); some framboidal;
- **barite:** common

Breccia limestone

- **pyrite:** contains < a few tenths As (no zoning); euhedral, and lacy networks of filamentous grains.



Acknowledgments

Andrew Legun provided unpublished field maps, airphotographs and lithogeochemical data. Jody Spence provided excellent field assistance in 1998 and contributed field data incorporated in this study. Cominco Ltd., Placer Dome Canada and Phelps Dodge Corporation of Canada Limited conducted exploration programs and their data is used in this study. Petrascience Consultants Inc. (Anne Thompson and Audrey Robitaille) completed PIMA on selected samples. Mike Fournier and Maurice Johnston produced several of the figures and scanned the plates.

Crowsnest 882135 Brown (Jan./99)