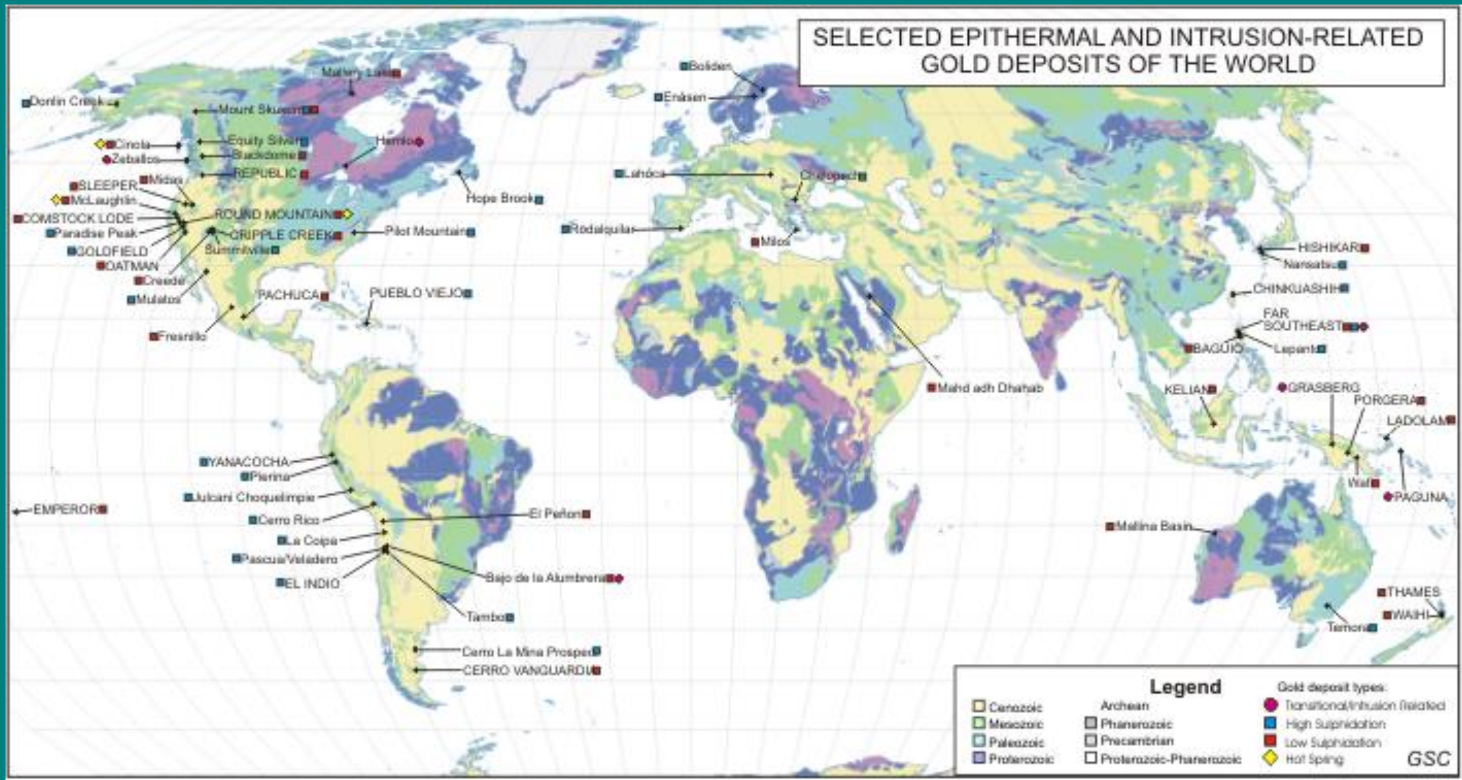
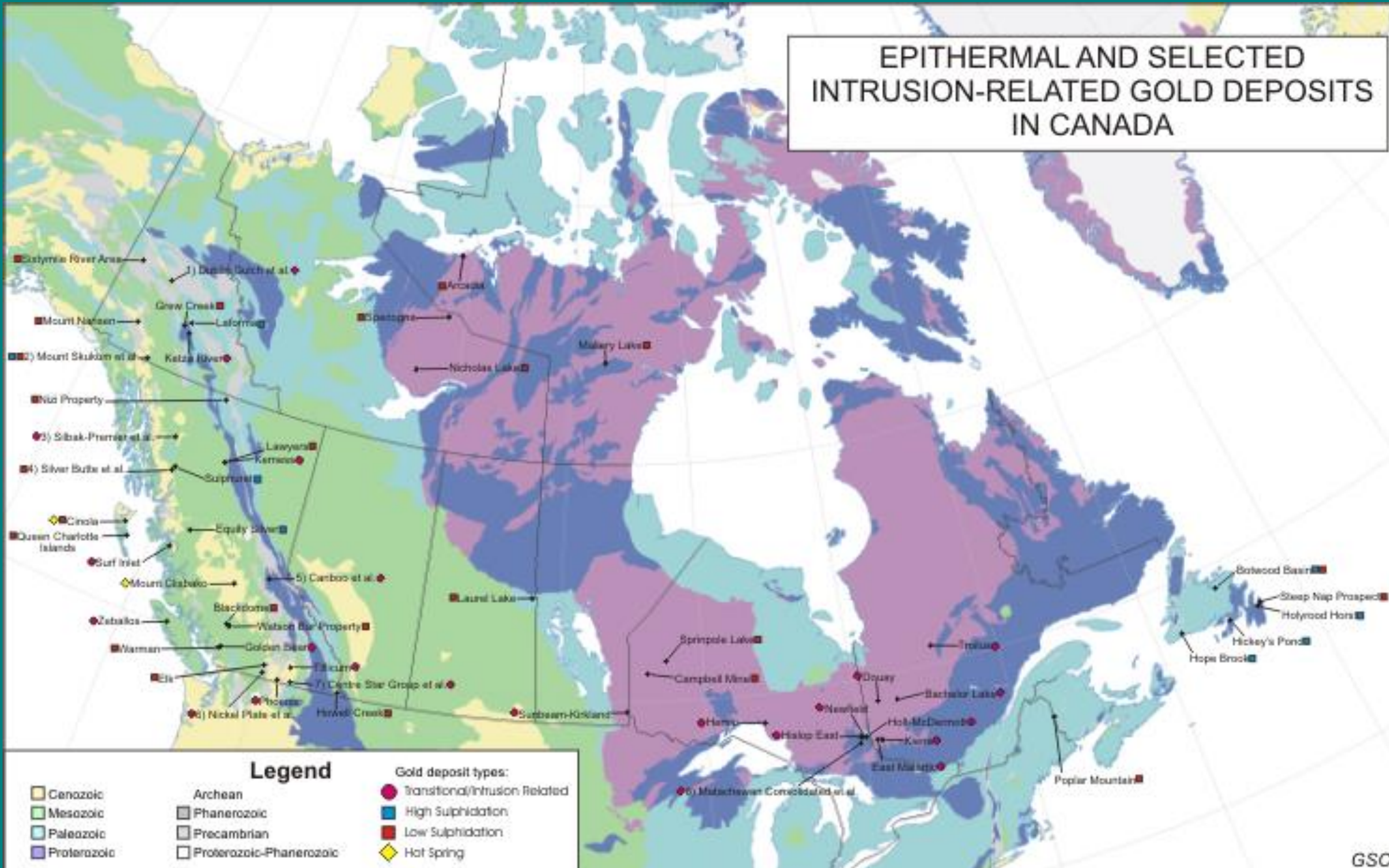
Epithermal Gold Deposits

(includes quartz-(alunite)-kaolinite and adularia-sericite deposits of *The Geology of Canadian Ore Deposit Types.* These are equivalent to high-sulfidation and low-sulfidation types in current terminology.)



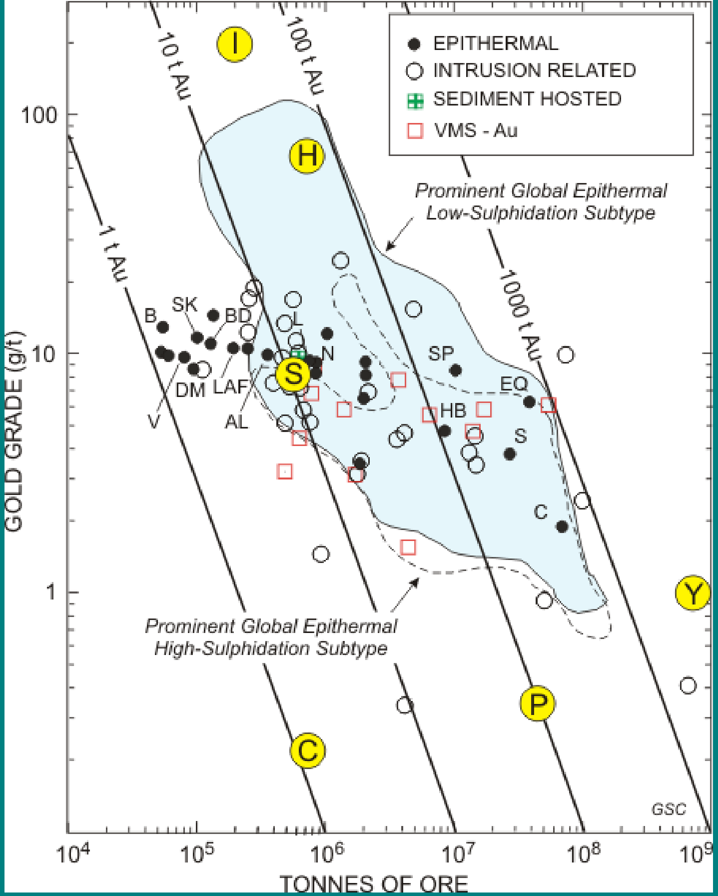
References:
Arancibia et al., 2006; Bethke et al., 2005; Carman, 2003; Deyell et al., 2005; Dubé et al., 1998; Fifarek and Rye, 2005; Goldfarb et al., 2004; Gosselin and Dubé, 2005a,c; Hedenquist et al., 2000; Huston et al., 2002; Klein and Criss, 1988; Naden et al., 2005; Panteleyev, 1996a,b,c, 2005a,b; Poulsen, 1996, 2000; Sillitoe, 1992, 1997; Taylor, 1996, this paper; Turner et al., 2003.

N.B.: Giant and Bonanza Gold deposits indicated by capitalization of deposit name, e.g., EL INDIO.



All Mines listed are largest deposits for area; in cases where more than one deposit is located, "et al." has been indicated as follows:
1) Dublin Gulch et al., includes: Dublin Gulch, Eagle Zone, Brewery Creek; **2)** Mount Skukum et al., includes: Mount Skukum, Skukum Creek, Mount Reid, Berney; **3)** Silbak-Premier et al., includes: Silbak-Premier, Spectrum,Banks, Banker, Tel, Yellow Giant, Johnny Mountain, Stonehouse, Snip, Twin Zone, Scottie, Salmon Gold, Premier, Bush, Silbak, Premier Gold; **4)** Silver Butte et al., includes: Silver Butte, SIB, Goldwedge, ; **5)** Cariboo et al., includes: Cariboo, Aurum, QR, Dome, Quesnel River; **6)** Nickel Plate et al., includes: Nickel Plate, Hedley; **7)** Centre Star Group et al., includes: Centre Star Group, Josie, Le Roi No. 2; **8)** Matachewan Consolidated et al., includes: Matachewan Consolidated, Young-Davidson, Ryan Lake.

References: Brown and Cameron, 1999; Dubé et al., 1998; Gosselin and Dubé, 2005b,d; Panteleyev, 1996a,b,c, 2005a,b; Poulsen, 1996, 2000; Taylor, 1996, this paper; Turner et al., 2003.



Plot of Au grade (g/t) versus tonnage (economic, or reserves+production) for selected Canadian epithermal Au deposits and prominent examples elsewhere in the world, classified by subtype as referred to in the text. Canadian epithermal deposits include Al = Al; B = Baker; BD = Blackdome; C = Cinola; DM = Dusty Mac; EQ = Equity Silver; L = Lawyers; LAF = Laforma; N = Mt. Nansen; SK = Mt. Skukum; SP = Silbak Premier; SUL = Sulphurets; and V = Venus. Hydrothermal vein deposits of a possible 'transitional' or 'deep epithermal' deposits are represented by open circles, sediment-hosted deposits by a green square with cross, and Au-bearing VMS deposits ('marine epithermal') by open red squares (see Appendix 1 in Dubé et al., 2007). The median grades and tonnages for several comparable types of deposits (yellow-filled circles) from Cox and Singer (1986) include porphyry Cu-Au [**P**]; low-sulphidation Creede-type [**C**]; intermediate sulphidation: polymetallic vein deposits associated with felsic intrusions [**M**]; and high-sulphidation: Summitville deposit [**S**]; and Lawyers deposit, Toodoggone River district, British Columbia [L; similar to the 'Comstock-type', Nevada (no symbol) of Cox and Singer, 1986]. Median values for the low-sulphidation Hishikari, Japan vein deposit [**H**], and for the high-sulphidation El Indio, Chile, deposit [**I**] are from Hedenquist et al. (2000). Fields for prominent low-sulphidation (blue shading) and high-sulphidation (dashed line) epithermal Au deposits worldwide (global) are based on data in Hedenquist et al. (1996; 2000).

Table 2.2 Characteristics of high- and low-sulfidation epithermal deposits

High-sulfidation Oxidized sulfur species (SO_2, SO_4^{2-}, HSO_4^-) in ore fluid/vapor	**Low-sulfidation** Reduced sulfur species (HS^-, H_2S) in ore fluid/vapor
Also referred to as Gold–alunite, acid–sulfate, alunite–kaolinite	Adularia–sericite, hotspring-related
Fluids Acidic pH, probably saline initially, dominantly magmatic	Near-neutral pH, low salinity, gas-rich (CO_2, H_2S), dominantly meteoric
Alteration assemblage Advanced argillic (zonation: quartz–alunite–kaolinite–illite–montmorillonite–chlorite)	Adularia–sericite (zonation: quartz/chalcedony–calcite–adularia–sericite–chlorite)
Metal associations Au–Cu (lesser Ag, Bi, Te)	Au–Ag (lesser As, Sb, Se, Hg)

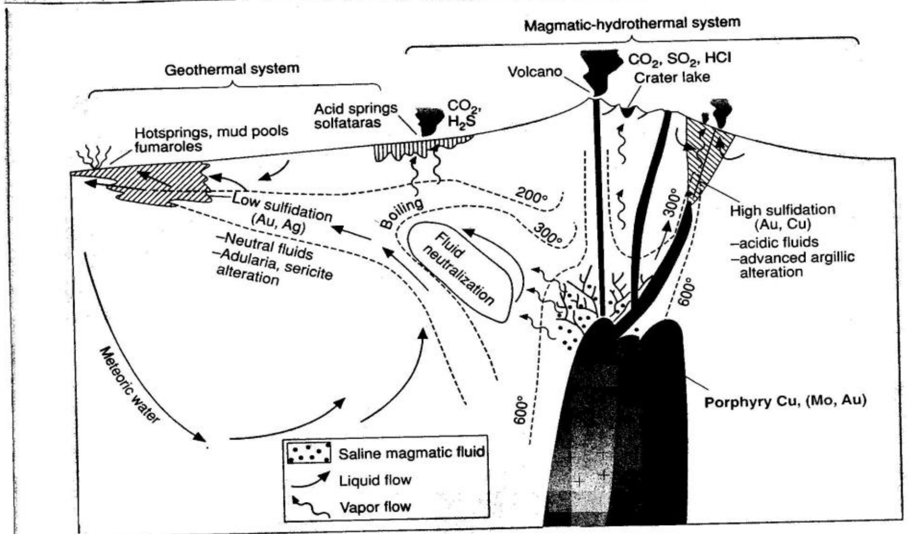


Figure 2.22 The geological setting and characteristics of high-sulfidation and low-sulfidation epithermal deposits. A genetic link between high-sulfidation epithermal Au–Cu and sub-volcanic porphyry type Cu–Au deposits is also suggested (after Hedenquist *et al.*, 2000).

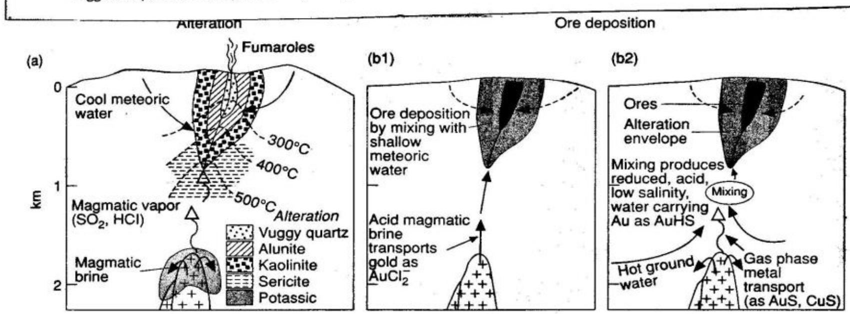
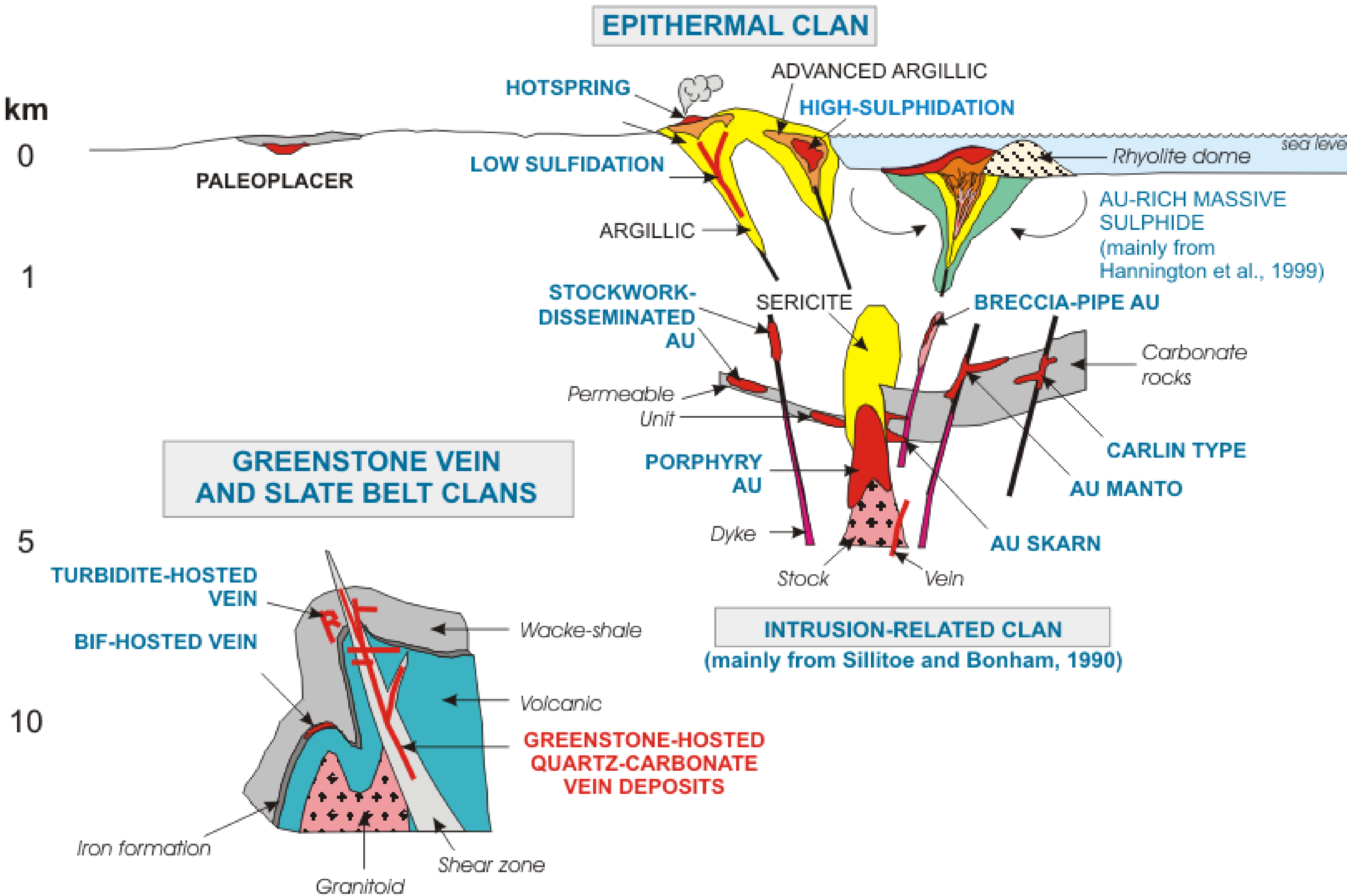


Figure 2.23 Two stage model for the formation of high-sulfidation epithermal deposits (after Arribas *et al.*, 1995). (a) Initial stage where a dominantly magmatic vapor phase is responsible for leaching of the country rock and development of an advanced argillic alteration halo around the main fumarolic conduit. (b1) Ore deposition stage, in this case where gold is transported as a chloride complex; and (b2) ore deposition stage where gold is transported as a bisulfide complex.


EPITHERMAL CLAN
km
0
1
5
10
ADVANCED ARGILLIC
HOTSPRING
HIGH-SULPHIDATION
sea level
Rhyolite dome
PALEOPLACER
LOW SULFIDATION
AU-RICH MASSIVE SULPHIDE
(mainly from Hannington et al., 1999)
ARGILLIC
STOCKWORK-DISSEMINATED AU
SERICITE
BRECCIA-PIPE AU
Carbonate rocks
Permeable Unit
GREENSTONE VEIN AND SLATE BELT CLANS
PORPHYRY AU
CARLIN TYPE
AU MANTO
Dyke
AU SKARN
Stock
Vein
TURBIDITE-HOSTED VEIN
Wacke-shale
BIF-HOSTED VEIN
INTRUSION-RELATED CLAN
(mainly from Sillitoe and Bonham, 1990)
Volcanic
GREENSTONE-HOSTED QUARTZ-CARBONATE VEIN DEPOSITS
Iron formation
Shear zone
Granitoid