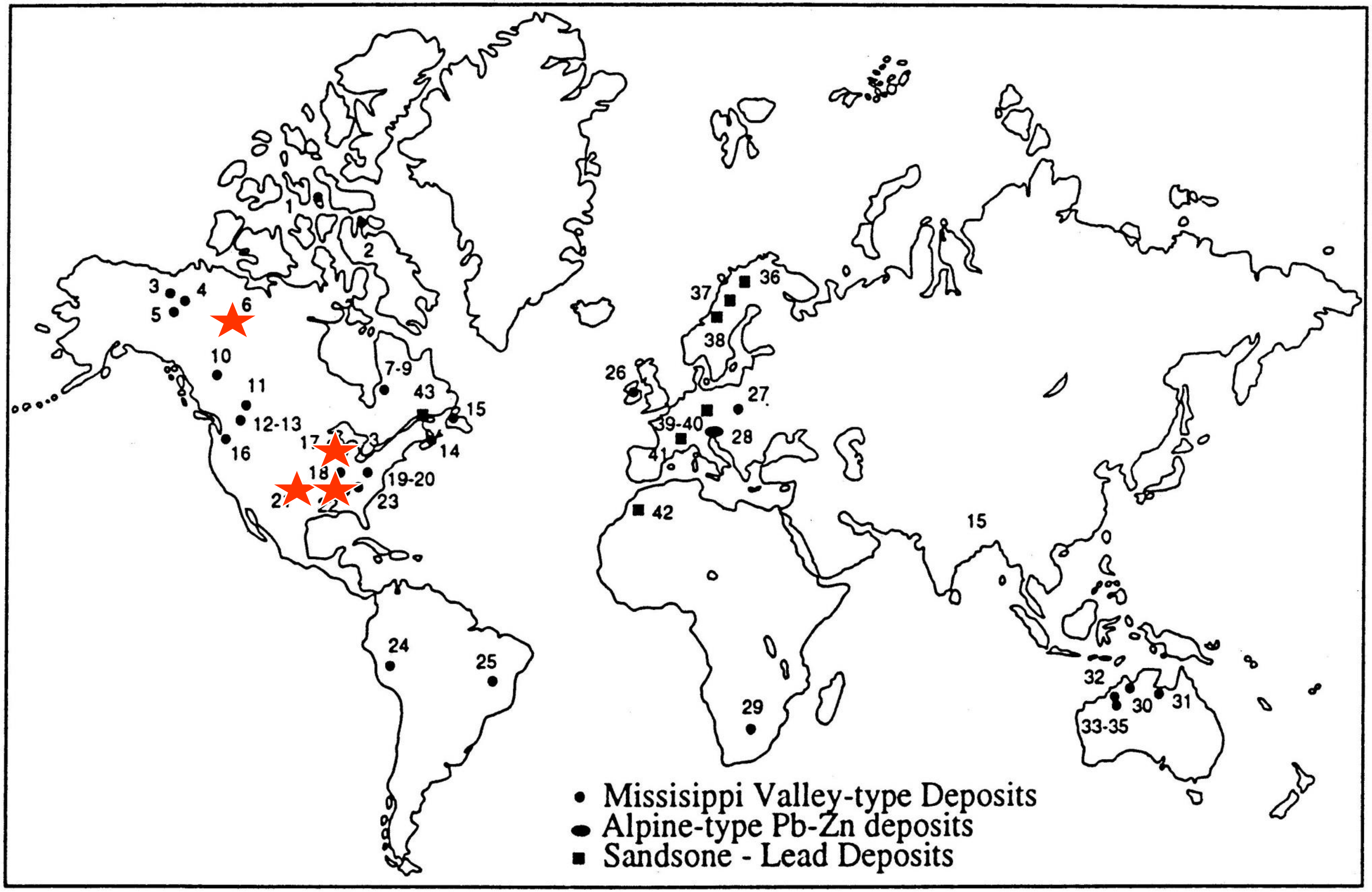
MVT Deposits

(Mississippi Valley Type Deposits)

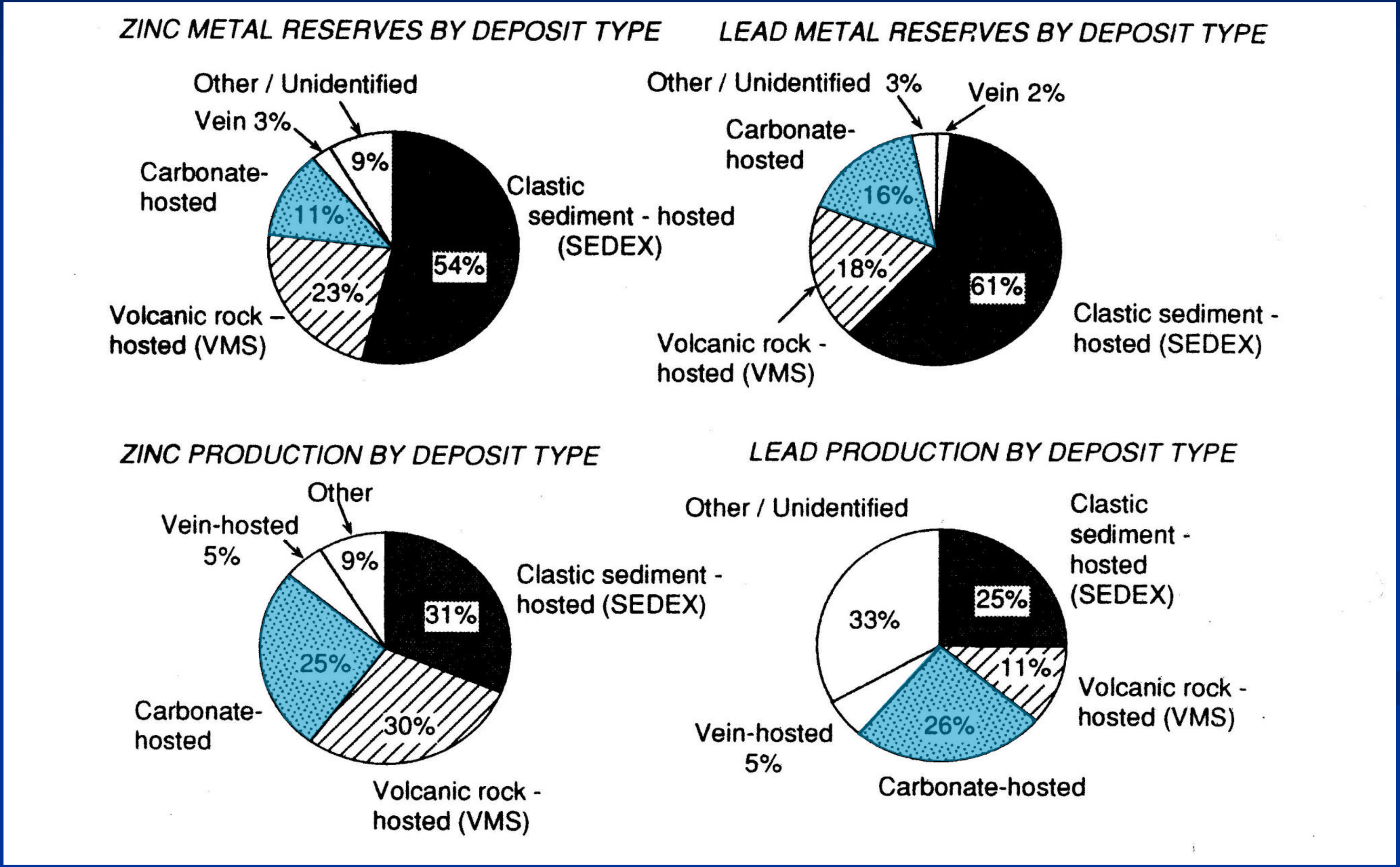
MVT Ores

Sphalerite and Galena in brecciated, dolomitized limestone

Distribution of MVT Deposits



Zn-Pb Reserves and Production by Deposit Type



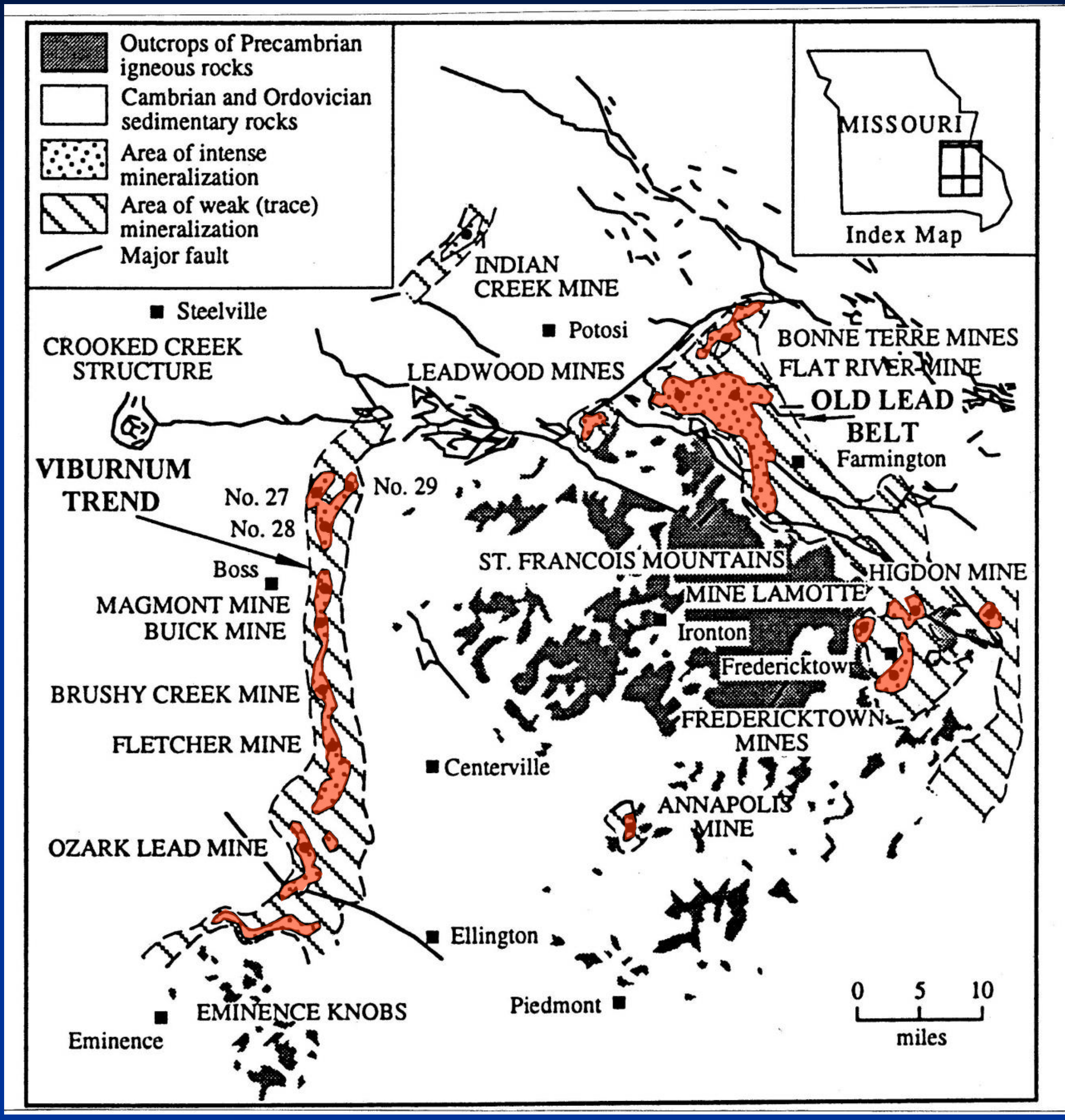
Grade and Tonnage Data for MVT Deposits

TABLE 13.1. Approximate grade and tonnage of selected Mississippi Valley-type Pb-Zn districts (after Gibbins 1983)

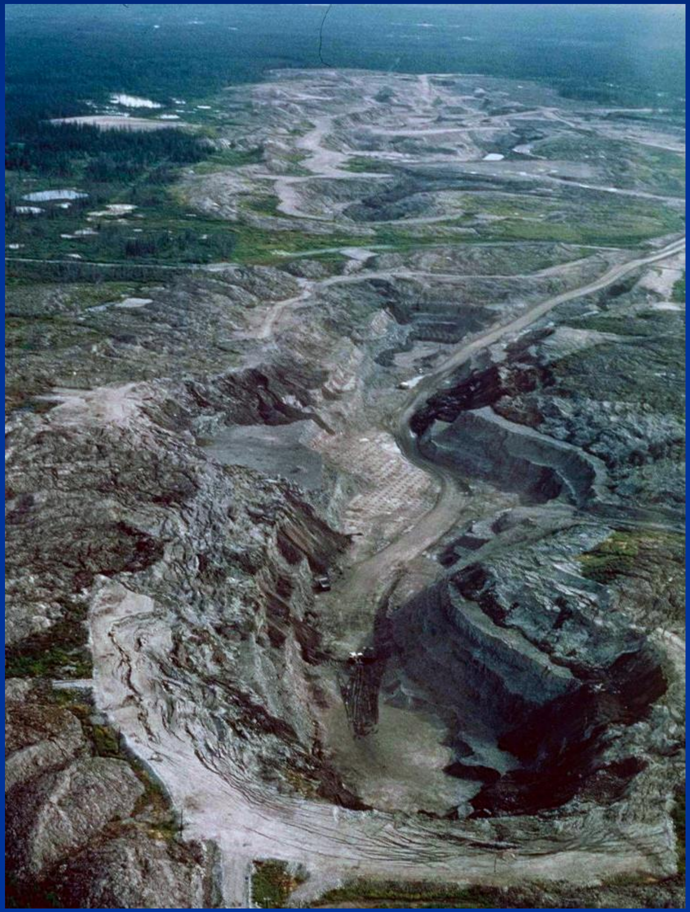
District	Tonnage (10^6 tonnes)	Zn (%)	Pb (%)
Pine Point, Canada	94.5	6.2	2.5
Cornwallis, Canada	24.1	13.8	4.2
Nanisivik, Canada *	6.4	11.5	1.2
Austinville, USA	25	3.7	0.7
Eastern Tennessee, USA	50	4.0	-
Illinois - Wisconsin, USA	100	5.0	0.5
Tri-State, USA	500	2.3	0.6
Old Lead Belt, Missouri, USA	340	-	3.0
Viburnum Trend, Missouri, USA @	420	1.0	6.0

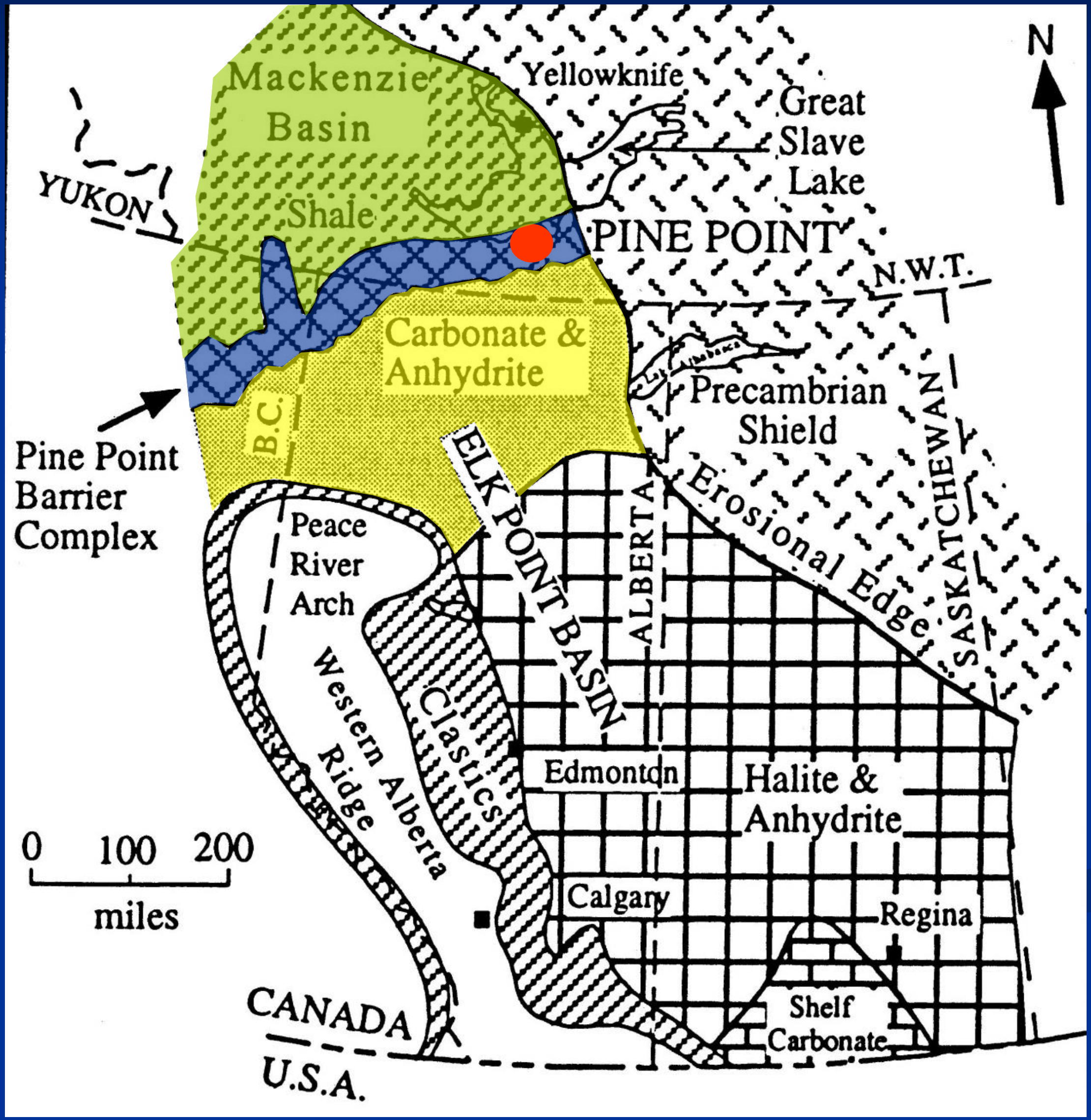
* Single deposit @ Estimated

The MVT Districts of the SE United States

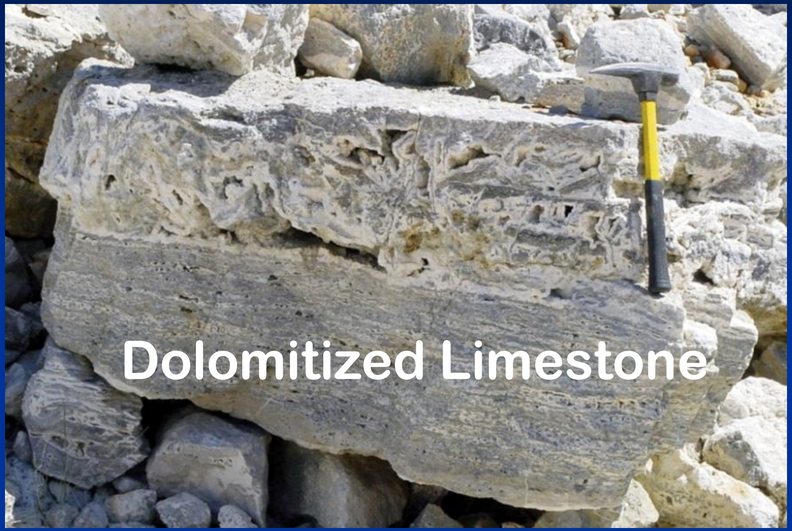


Geological Setting of Pine Point

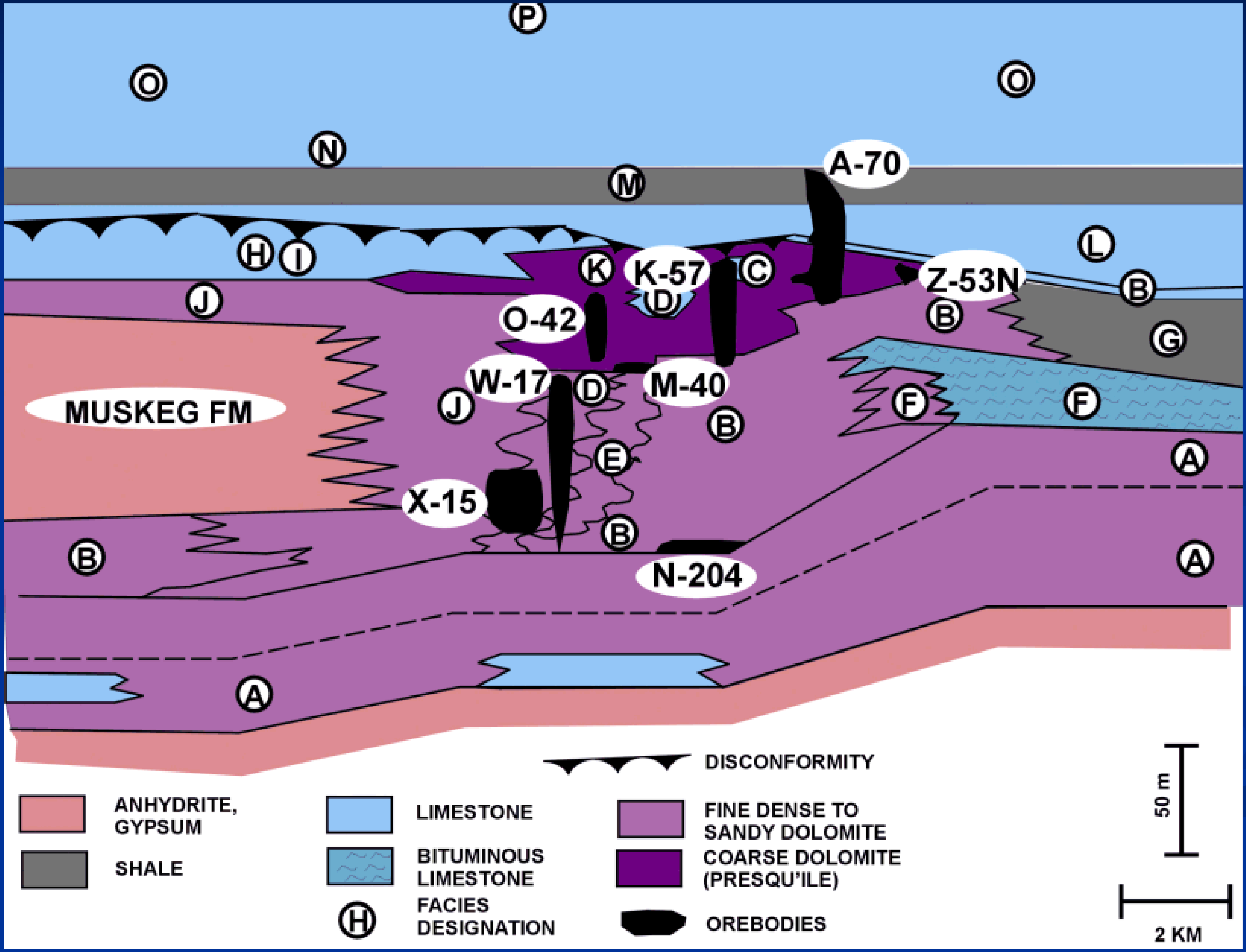




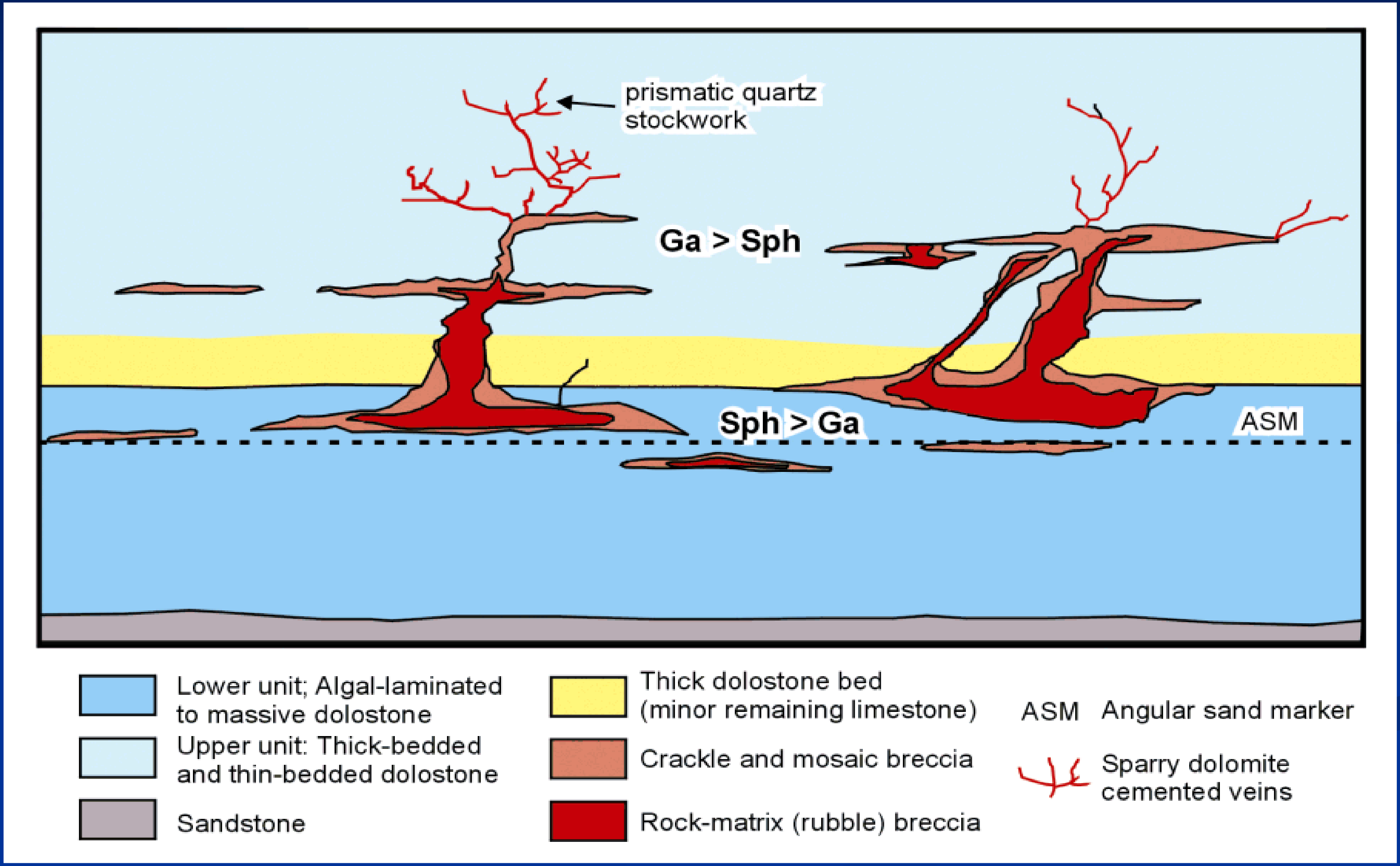
Pine Point Ore and Host Textures



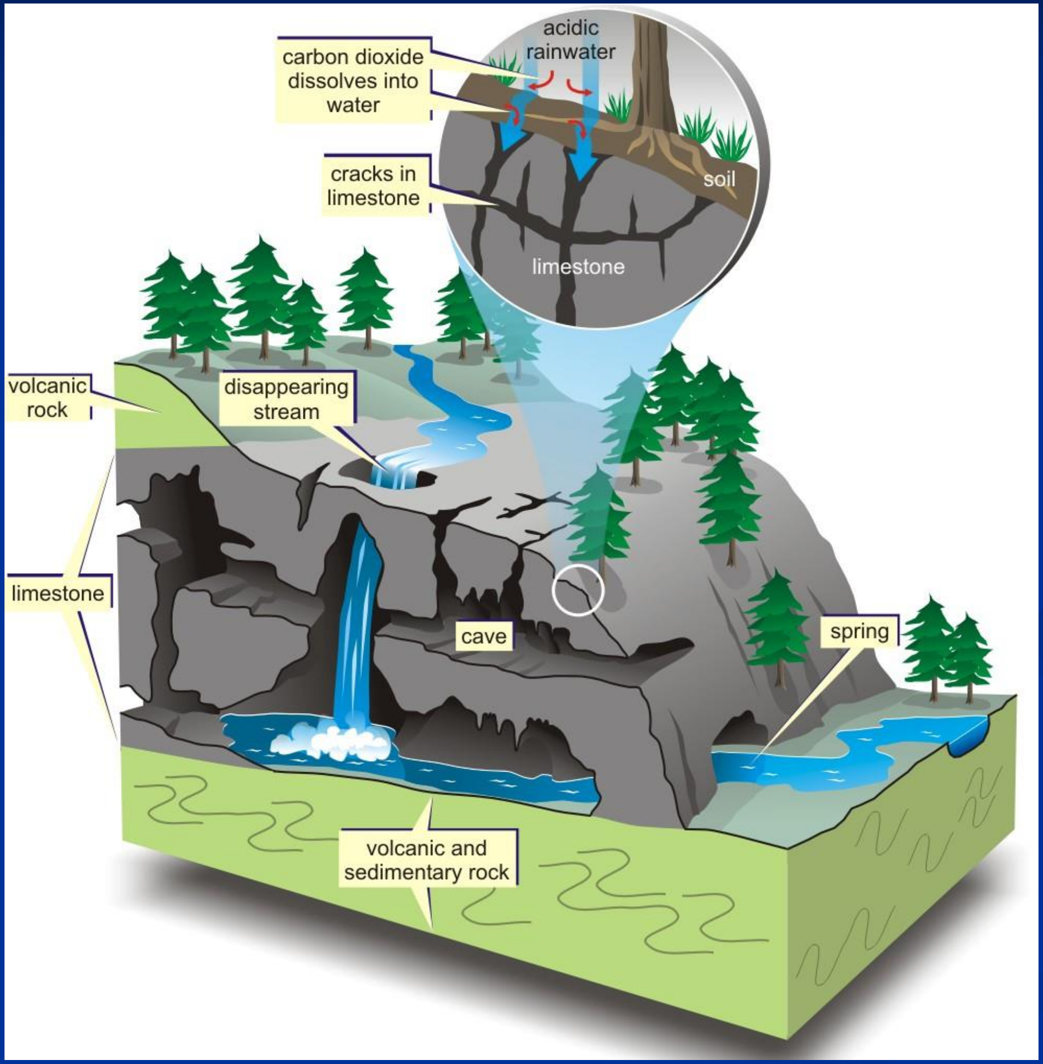
Cross-section through the Pine Point Deposit

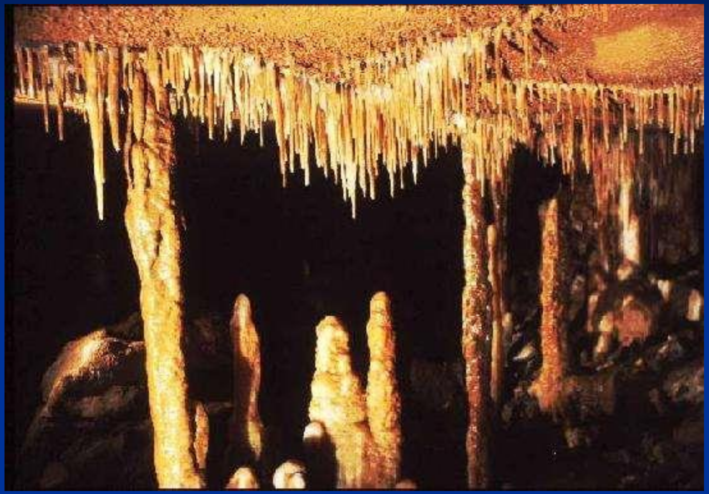


Cartoon of the Robb Lake MVT Deposit, Yukon



Karst Formation





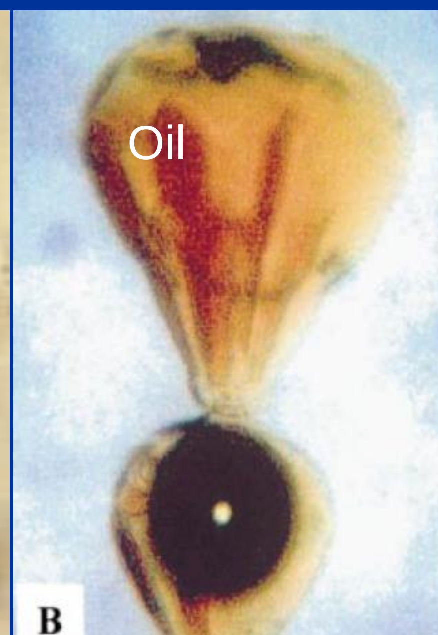
Fluid Inclusion Data

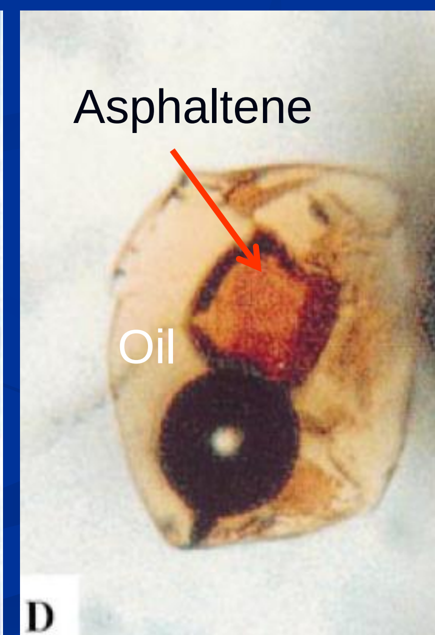
Th: 125 – 200 ºC

Salinity : ~ 15wt% NaCl eq.

2-Phase Aqueous Inclusions

Oil-bearing aqueous inclusions





Composition of MVT Fluids

Comparison of the compositions of fluid inclusior from Mississippi Valley-type deposits with the compositions of base-metal-bearing oil-field brine

	Fluid inclusions	Oil-field brine
T (°C)	75-150	130-150
P (bar)	<500	388-843
Cl (mg L^{-1})	59,000-120,000	71,520-207,400
Na (mg L^{-1})	27,000-53,400	29,000-79,100
Ca (mg L^{-1})	17,000-20,400	4,140-74,800
K (mg L^{-1})	2,500	243-7,080
Na/K[a]	12-42	40-370
Na/Ca[a]	3-7	1.4-17
Zn/Pb[a]	Unknown	3-25

TABLE 20-2. Composition of Selected U.S. Oil Field Brines

Locale	Source Rock Age	Dissolved Solids, ppm	Dissolved Metal, ppm					
			Pb	Zn	Cu	Fe	Ba	Hg
Michigan	Silurian	400,000	10	2	—	10	11	—
Mississippi	Cretaceous	320,000	111	357	—	420	59	—
Mississippi	Cretaceous	255,000	80	300	—	298	61	—
Alabama	Jurassic	486,000	215	39	—	467	504	—
Arkansas	Jurassic	351,000	<1	<1	—	3	34	—
Texas	Cretaceous	344,000	226	706	—	1060	1090	—
Texas	Oligocene	75,000	8	190	0–6	140	—	8

Sulphur Isotopic Composition of MVT Deposits

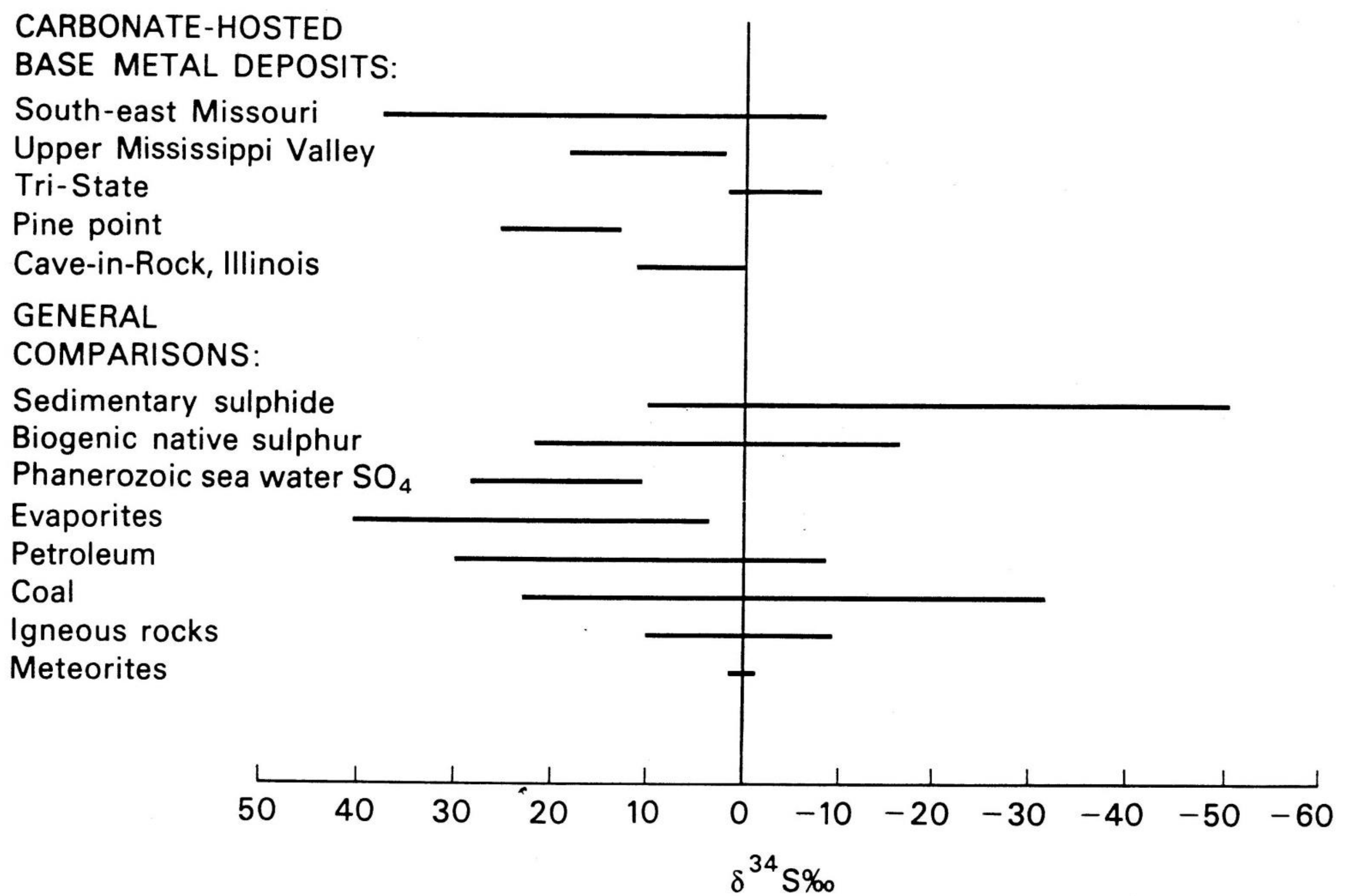
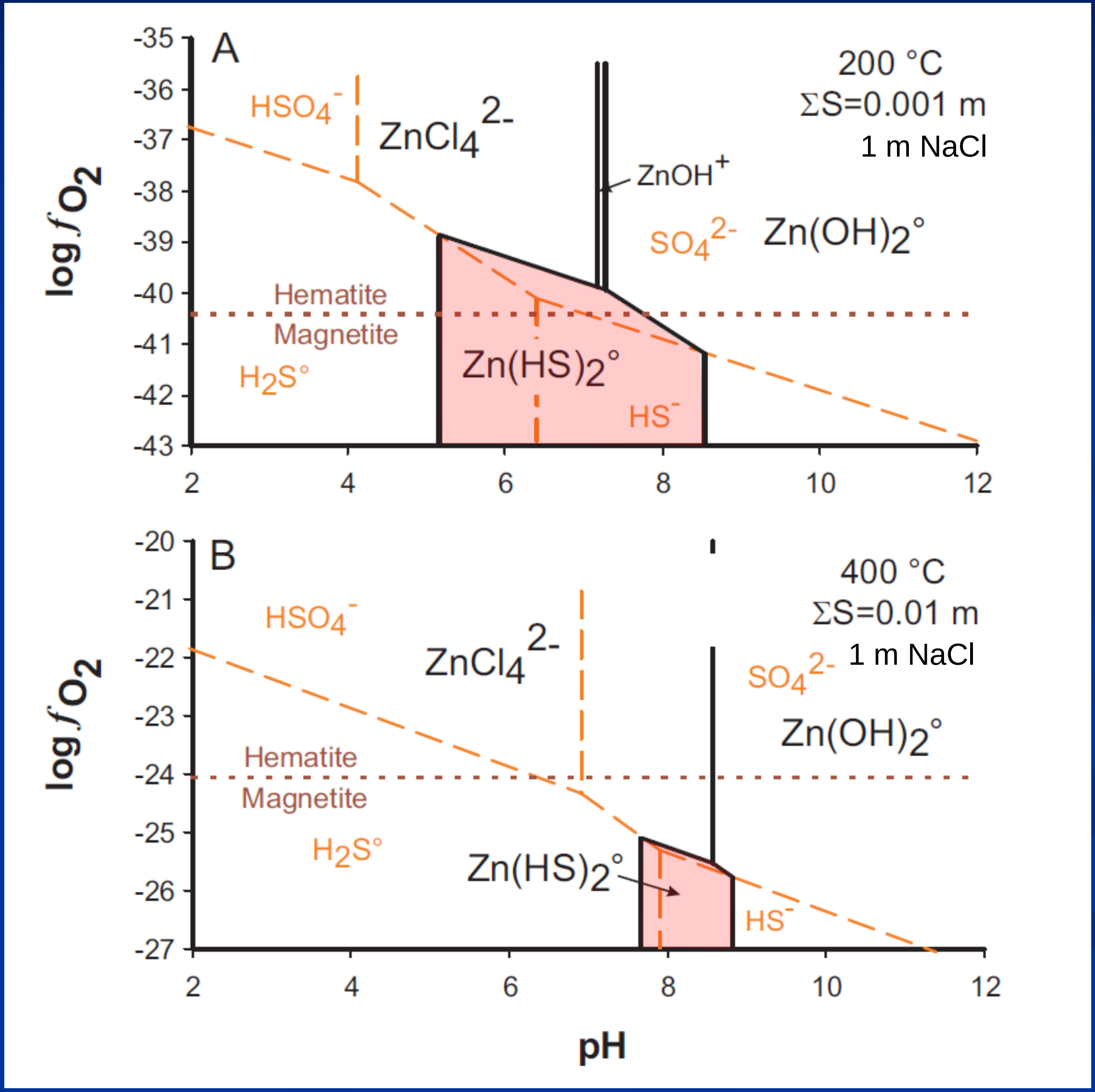


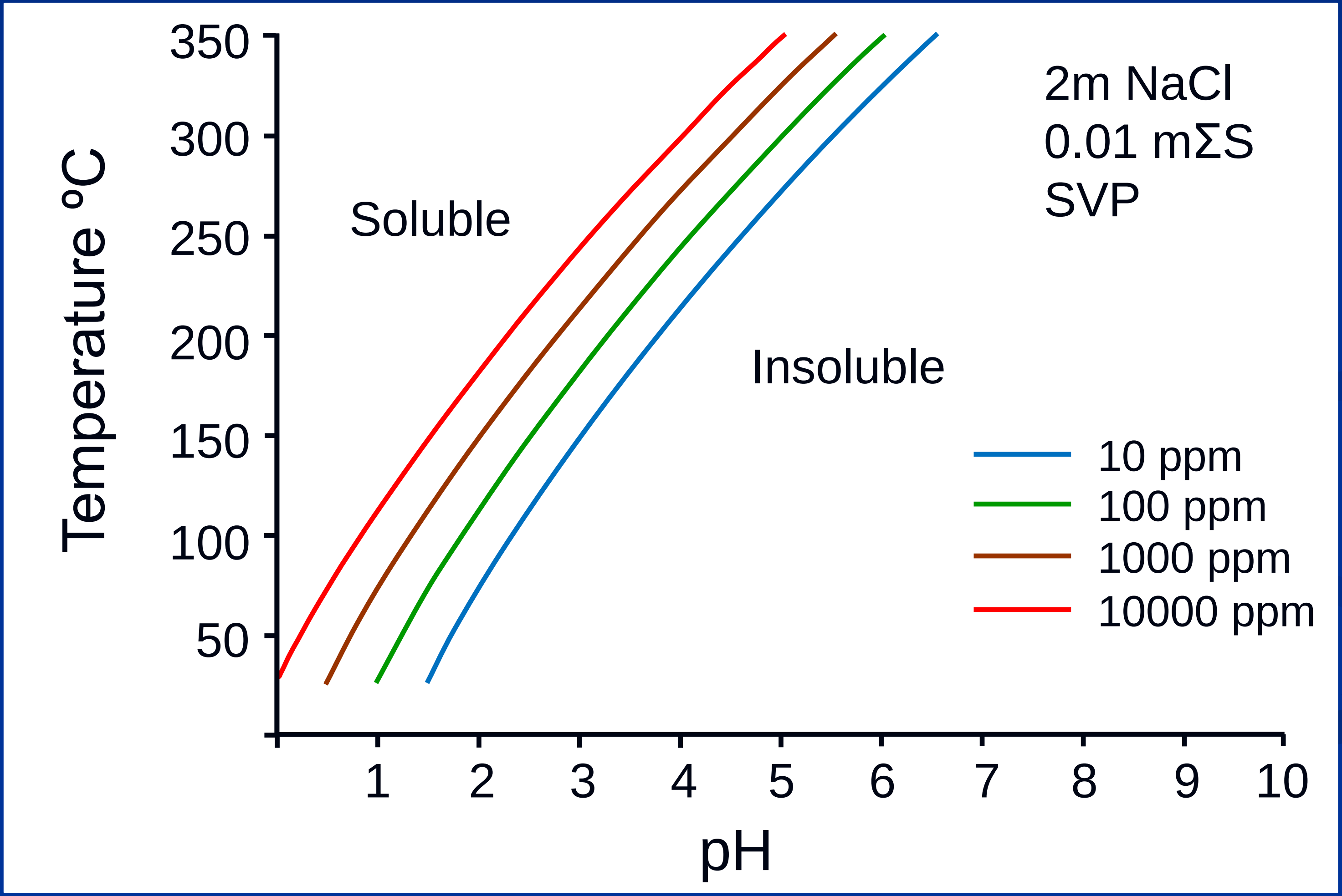
Fig. 17.2 The range of $\delta^{34}S$ for some carbonate-hosted, base metal deposits and the range for major sources of sulphu[r] that could have contributed to the ore deposits. (Modified from Heyl *et al.* 1974.)

Zinc Speciation in Aqueous Liquid

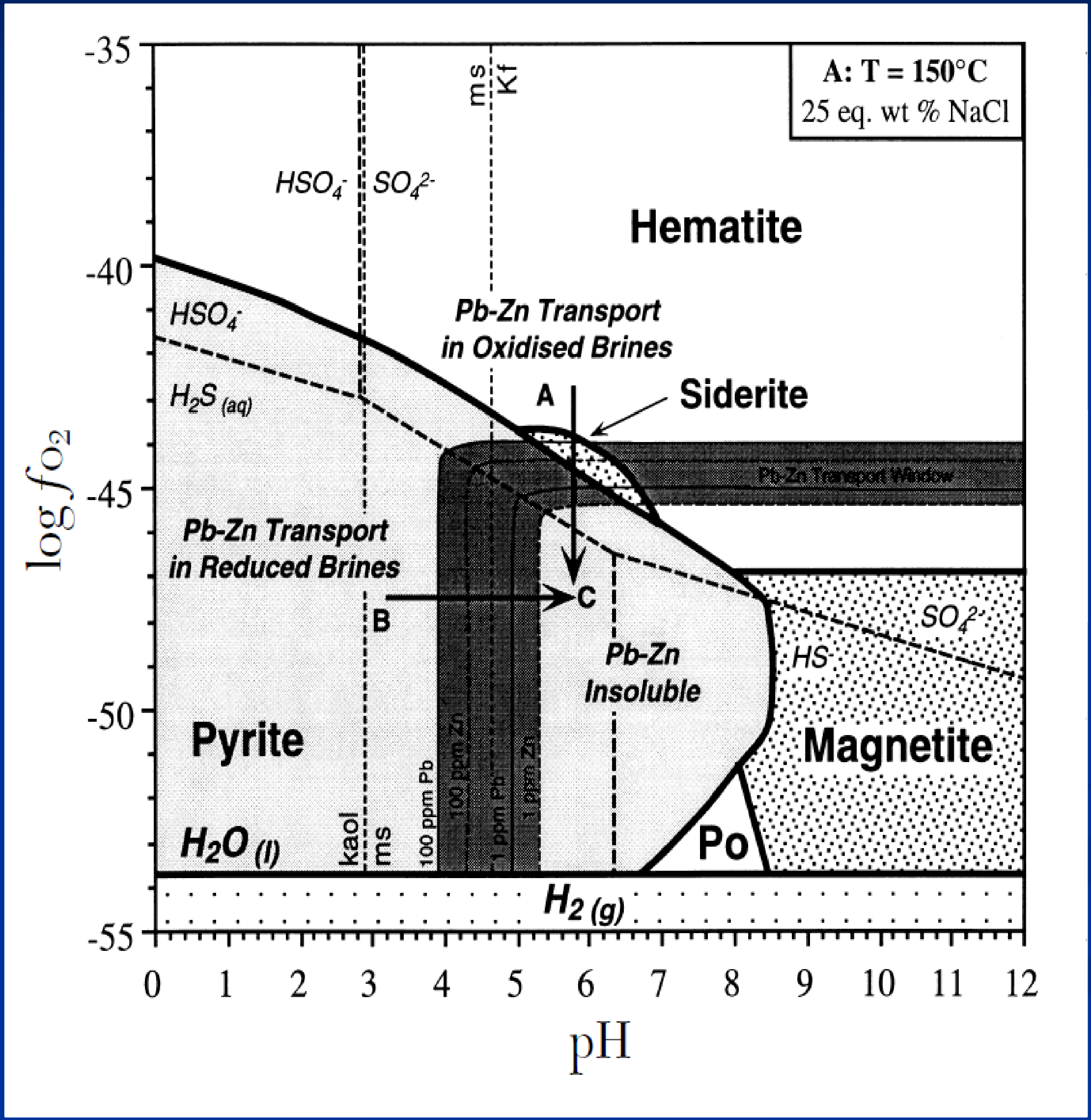


Solubility of Sphalerite as a Function of Temperature and pH

(Based on data of Ruaya and Seward 1986; Tagirov and Seward, 2010)



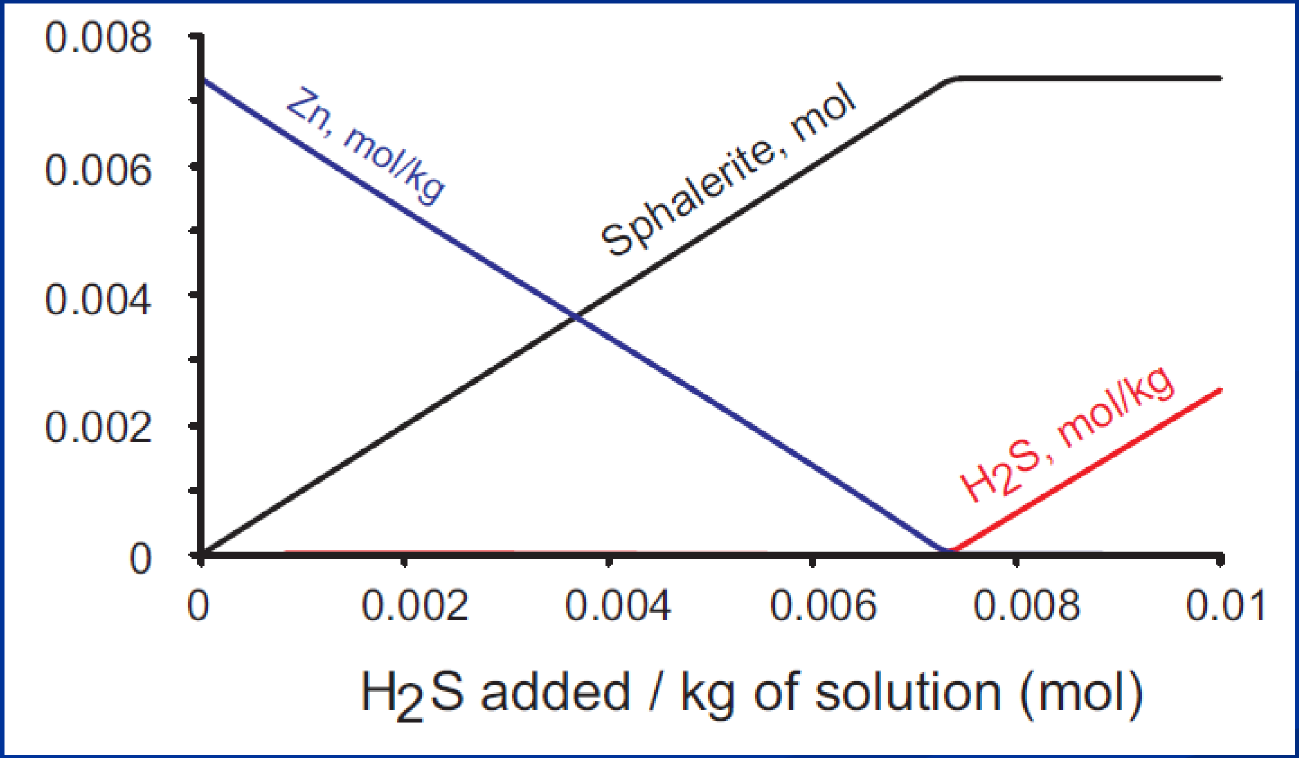
Zinc Speciation in Aqueous Liquid



A constraint on MVT Ore Formation

Can reduced sulphur be transported with zinc?

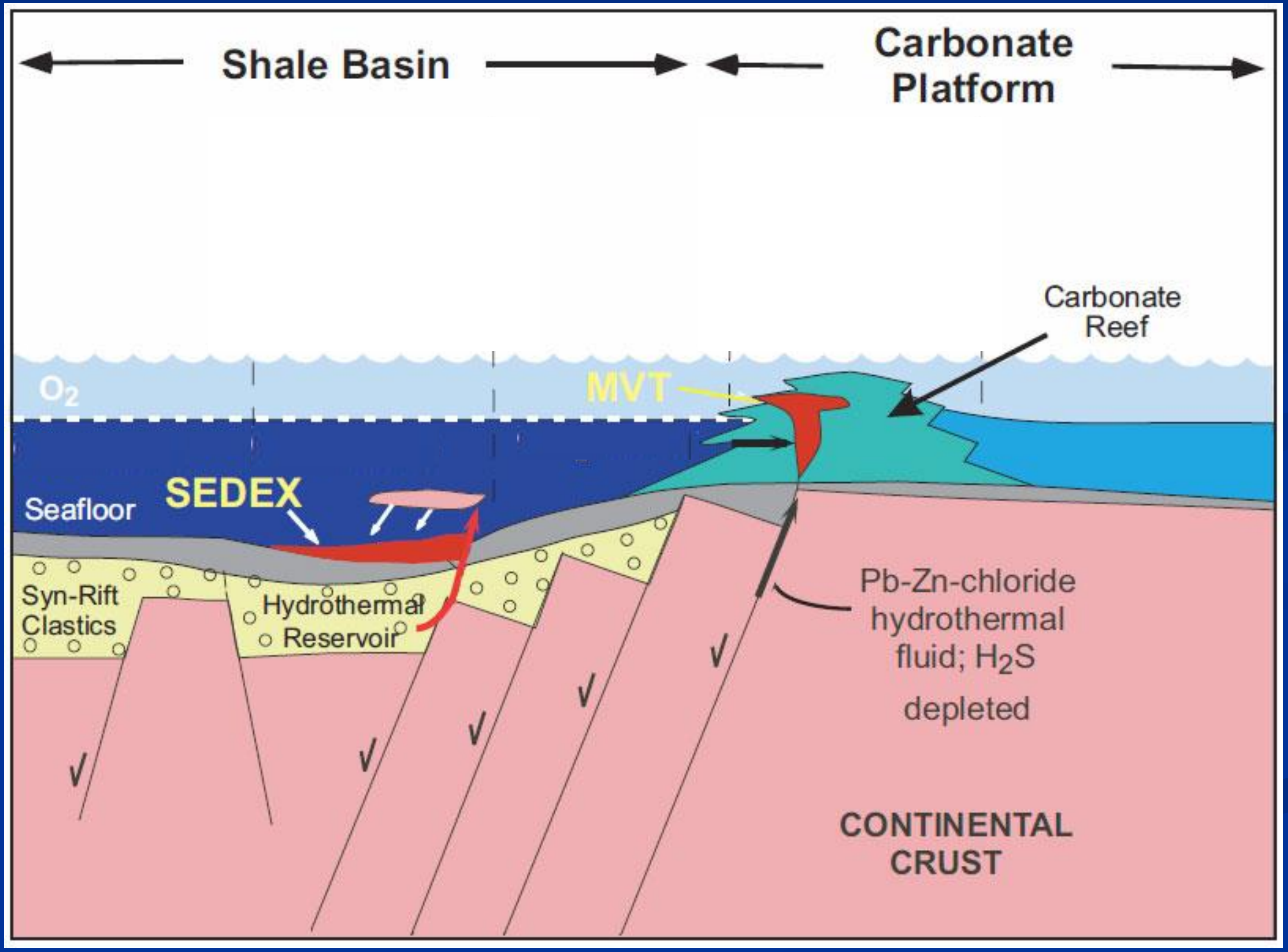
Metalliferous brine containing 15 wt.% NaCl and 1000 ppm Zn



Sphalerite will precipitate even in the presence of vanishingly small concentrations of H_2S. Ore metals and reduced sulphur must be transported separately.

Williams-Jones and Migdisov (2014)

Towards a genetic model for MVT Pb-Zn deposits



Genetic Model for MVT Deposits

- Oil and then brine released from clastic sedimentary basin
- Dissolution of reefal limestone creates porosity (Karst)
- Oil leaves residues in limestone
- Basinal brine leaches Pb, Zn from sandstones, shales
- Basinal brine transports metals to porous limestone reef; dolomitizes limestone
- Backreef brine transport sulphate to reef
- Galena and sphalerite deposit as a result of mixing of metalliferous brine with sulphate-bearing brine, reduced by interaction with oil residues.

$$ZnCl^{+} + SO_4^{2-} = ZnS + Cl^{-} + 2O_2$$

$$PbCl^{+} + SO_4^{2-} = PbS + Cl^{-} + 2O_2$$