British Columbia
Canada's Pacific Gateway

Ministry of Energy, Mines and Petroleum Resources

FLUORSPAR MARKET REVIEW AND SELECTED FLUORITE DEPOSITS IN BRITISH COLUMBIA, CANADA

George J. Simandl[1,2]

[1]British Columbia Ministry of Energy Mines and Petroleum Resources, Victoria, BC, Canada. [2]School of Earth and Ocean Sciences, University of Victoria, BC, Canada

British Columbia Geological Survey

Suggested reference style:
Simandl G.J.(2009): Fluorspar market and selected fluorite-bearing deposits, British Columbia, Canada. *British Columbia Ministry of Energy and Mines; Geofile 2009-03. Poster.*

Introduction

Fluorspar is the commercial term for fluorite (CaF_2). Fluorite contains 51.1% Ca and 48.9% F. Collector specimens occur as cubes and octahedrons. Typical fluorspar ores are massive , disseminations, or form layered crusts, globular and botroidal aggregates and cox-comb textures. Other sources of F are cryolite and phosphate rock. Cryolite (Na_3AlF_6) was historicallymined in Greenland. Due to environmental pressure, F compounds are now recovered during the processing of sedimentary phosphates. Fluosilic acid (H_2SiF_6), used in water fluoridation, is one of these compounds. Strict environmental regulations suggest that this acid will be increasingly converted into Al- or Ca-fluorides, cryolite, or H. Phosphate rock reserves in the USA alone contain 370 million tonnes of F. Fluorspar is used largely in the manufacturing of fluorocarbons for refrigerants, foam products, polytetrafluoroethylene ("Teflon") and other fluoropolymers. Petroleum alkylation, glass, medical, agricultural and metallurgical uses also represent important markets. Demand for fluorspar in the manufacture of fluoropolymers and fluoroelastomers, including partially fluorinated polymers or copolymers is growing. Over 70% of fluorspar used in developed countries is transformed into HF products, while in developing countries over 65% of fluorite is used in steel-making. Fluorspar uses in USA are summarized on Figure 1. Aluminum fluoride (AlF_3) and synthetic cryolite, derived largely from acid grade fluorspar, are the main F compounds used in aluminum (Al) smelting. The growth of this market is favoured by increasing demand for Al in the automotive industry, but it is counterbalanced by improvements in smelting technology, increased recycling of both, Al and F, and by increased use of AlF_3 derived from fluosilic acid. Fluorspar products are sold to steel mills, cement plants, foundries, glass and ceramic plants, and welding rod manufacturers where they are used as fluxes.

Fluorspar Production and Prices

Fluorspar production first exceeded 1 million t/year during World War II (Figure 1). It peaked at 5.56 million t/year in 1989 and then bottomed out at 3.75 million t/year in 1994 due to restrictions on the use of fluorocarbons (particularly CFCs) related to the Montreal Protocol.. The market stabilized in the 4.2 - 4.5 million t/year range between 1997 and 2000. By 2004 fluorspar production consistently exceeded 5 million t/year (US Geological Survey, 2007). The variation in price of fluorspar in the USA over the last 100 years is shown on Figure 2.

Major Fluorspar-producing Countries

In 2007 world fluorspar production was 5.59 million t (Miller, 2008b). China, at 3.2 million t, is the largest fluorspar producing country (Figure 4) and strongly influences fluorspar prices. It is followed by Mexico (933 000 t), Mongolia (380 000 t), South Africa (285 000 t), Russia (180 000 t), Spain (155 500 t), Namibia (118 000 t) and Morocco (95 000 t). Recently, China has been diverting an increased proportion of its fluorspar output to domestic production of HF and thus its fluorspar exports shrinked. Prices of fluorspar concentrates have risen in terms of US dollars (Figure 2), creating opportunities for fluorspar producers outside of China. Since the summer of 2007, economic growth in China slowed down and it remains to be seen if China will maintain its export restrictions..

Fluorspar Geology

Fluorite occurs in variety of geological settings. It is the only (or the main) ore mineral in classical deposits: such as: Las Cuevas, Encantada-Buenavista, El Triangulo, (Mexico); St. Lawrence pluton-related veins and the Rock Candy Mine (Canada); El Hamman veins (Morocco) and Le Burc, Montroc Le Moulinal and Trebas deposits (France). Fluorite also occurs in association with other industrial minerals or metals in carbonatites and alkaline complexes, Mississippi Valley type Pb-Zn-fluorite-barite deposits, fluorite-barite-(Pb-Zn) veins, hydrothermal Fe (± Au, ±Cu) and REE deposits, precious metal concentrations, fluorite/metal-bearing skarns, Sn-polymetallic greissen-type deposits, zeolitic rocks and uranium deposits. At first glance the co-production of fluorite with metals appears an attractive proposition but in most cases such association represents increased capital and processing costs. From the engineer's point of view, economic fluorite deposits occur as simple or composite veins, stockworks and breccia zones (Figures 5 and 6), diatreme pipes, disseminations (Figure 7) or other features where fluorite occurs as open space fillings (such as in karst). Replacement-type, residual (unconformity-related) and stratiform bodies are also known to form high-grade deposits. Vein-type deposits have historically supplied the majority of the fluorspar market. Grade and tonnage curves (Figures 8 and 9) cover vein-type deposits. These curves were originally produced for mineral potential assessments, but they can be used during the early screening of exploration projects. The vertical axis of these diagrams extends from zero to one. The horizontal axis represents either tonnage or grade (% CaF_2). For example, from Figure 8 we can determine that 90% (0.9 on the vertical scale) of fluorite vein-type deposits have grades (CaF_2. content) higher than 23%. Half (0.5 on the vertical scale) of these deposits grade higher than 44% CaF_2. Less than 10% (0.1 on the vertical scale) of the deposits have a grade higher than 64 % CaF_2. The same approach is used to interpret the Figure 9. High grade, large tonnage deposits are preferred targets. The shape, orientation, depth of mineralization and geotechnical parameters determin if fluorspar is extracted by surface or underground mining (Figure 10 and 11). For large, medium to low grade ore deposits containing minerals with similar properties to fluorspar, the processing circuit are complex. Heavy-media separation, followed by differential flotation , combined with other methods are common practice. Fine-grain flotation concentrates (or dust) may be pelletized or briquetted to satisfy consumer needs. Deposits, able to provide coarse and high-grade fluorite-rich ores (or usable concentrate requiring simple metallurgical processing) are primary exploration targets, but other large tonnage, lower grade deposits are being investigated. The presence of metallic minerals within fluorite ore may improve or impair the economic viability of a deposit. If metallurgical and economic parameters are satisfied, fluorspar is recovered as by-product of metal mining (e.g. Pb-Zn veins, Mississippi Valley type Pb-Zn deposits,, barite-fluorite, REE-fluorite and uranium-fluorite deposits), where fluorite accounts for 10% or more of the ore. Fluorite is also recovered from tailings associated with historic mines in Mexico and Europe.

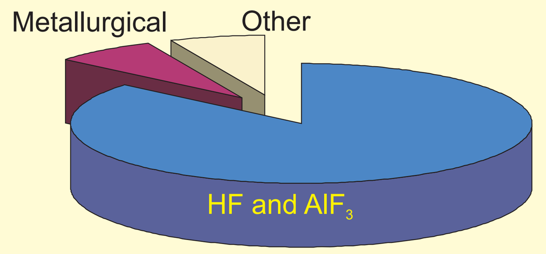

Figure 1. Fluorspar use in USA. Data from Miller (2008b).

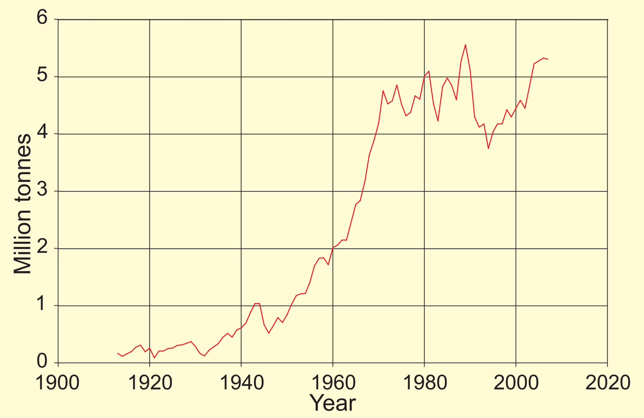

Figure 2. World Fluorspar production

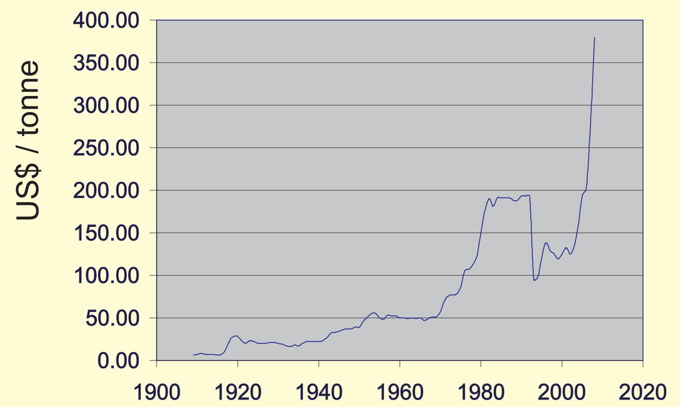

Figure 3. Fluorspar prices in USA.

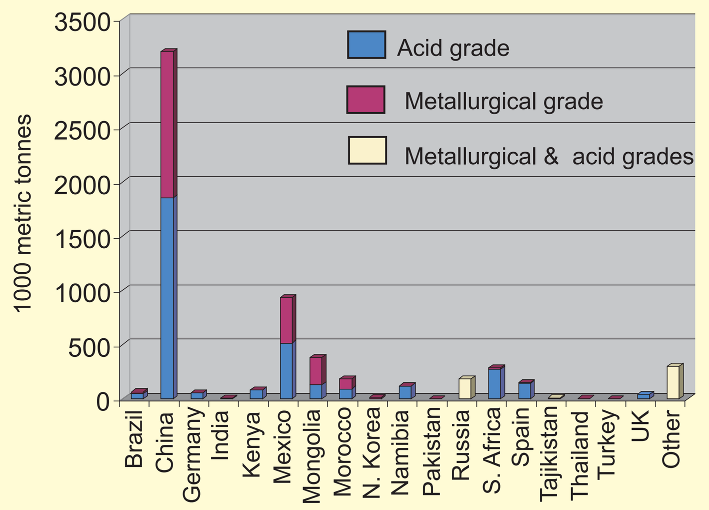

Figure 4. World metallurgical and acid grade fluorspar production by country for the year 2007. Data from Miller (2008b).

Figure 5: Coarse fluorite (pale to dark green) cementing a breccia and replacing fragments of the host rock. Rock Candy mine, southern British Columbia, Canada.

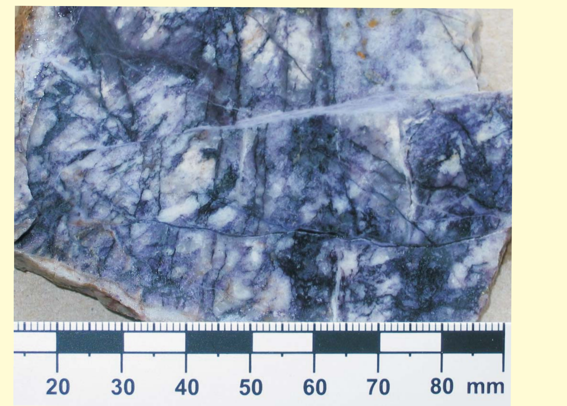

Figure 6: Crackle breccia. Dark purple, fine-grained fluorite fills fractures and replaces pale gray limestone. Rock Canyon Creek deposit, southeastern British Columbia, Canada.

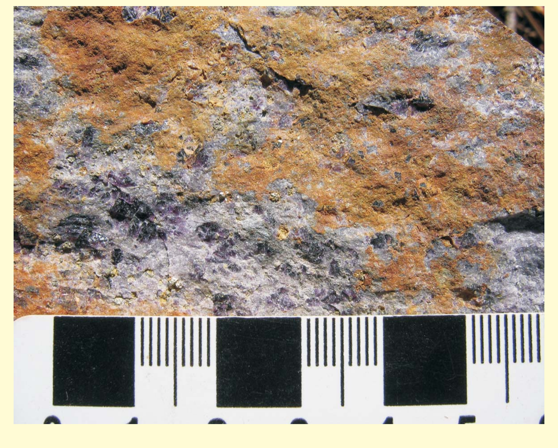

Figure 7: Fluorite disseminated in trachytic meta-tuff, Rexspar deposit, central British Columbia, Canada. Fluorite is purple to almost black. Weathered sulphides give rock rusty-brown appearance (fine division on the scale = 1mm).

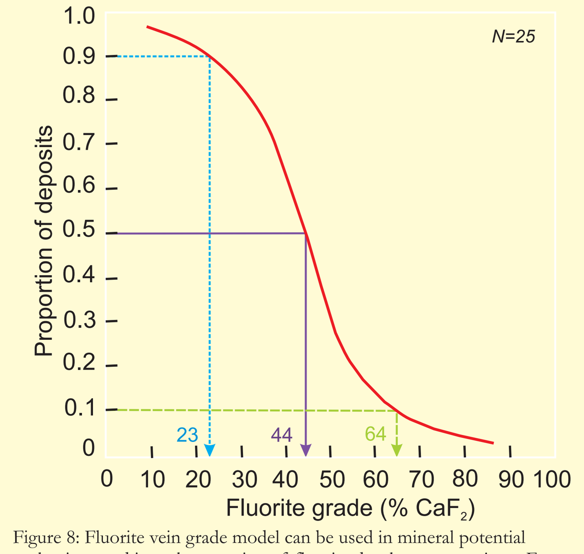

Figure 8: Fluorite vein grade model can be used in mineral potential evaluations and in early screening of fluorite development projects. From Orris (1992).

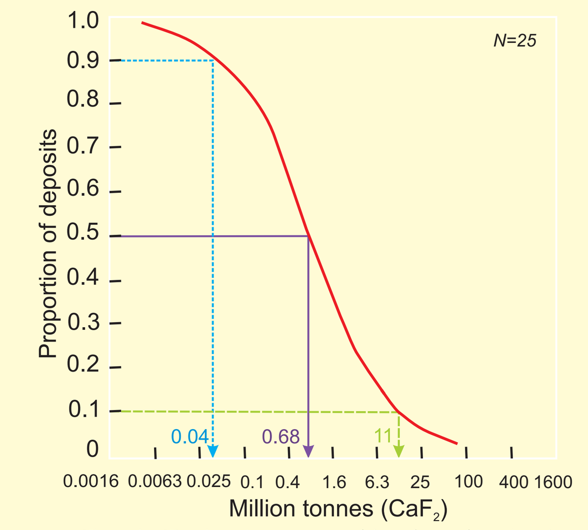

Figure 9: : Fluorite vein tonnage model can be used in mineral potential evaluations and in early screening of fluorite development projects. From Orris (1992).

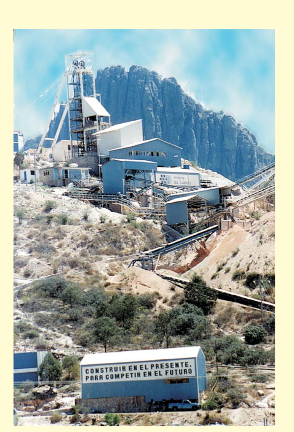

Figure 10: Underground Fluorspar Mine located near Potosi, Mexico; photo used with permission of MEXICHEM.

Figure 11: Large open pit fluorite mine, within the giant Vergenoeg fluorite - iron oxide - fayalite pipe, South Africa. White pick-up truck for scale. Photo used with permission of Vergenoeg Mining Company Ltd.

Figure 12: Acid grade fluorspar concentrate; particles are less than 1 mm in size. Photo used with the permission of the MEXICHEM.

Figure 13: Metallurgical grade fluorspar concentrate. The ruler is in inches and centimeters for scale. Photo used with the permission of the MEXICHEM

Fluorite Ores and Grades of Concentrate

The texture, mineralogy and chemistry of the mine-run are reflected in the silica, sulphur, calcite and minor and trace element content of fluorite concentrates, affecting the marketability of products.Concentratess are subdivided into ceramic, metallurgical and acid grades (Harben, 1999; British Geological Survey, 2005).

Ceramic grade is commonly fine-grained and subdivided to No.1 product - 95-96% CaF_2, < 3% SiO_2, <0.12 ferric oxides, low calcite content and traces of Pb and Zn and No.2 product contains 85% to > 90% CaF_2.

Acid grade concentrate must contain more than 97% CaF_2, < 1.5% SiO_2, 0.03 0.10% S (as sulphide or free S), <12 ppm As, 100 - 550 ppm P, plus low concentrations of Pb, Cd, Be, $CaCO_3$ and moisture (Harben, 1999). This grade is produced by the flotation process so its particle size is typically 100 mesh or lower (Figure 12).

Metallurgical grade concentrate must contain > 80% CaF_2, < 15% SiO_2, and the material must pass through a 1.0 to 1.5 inch screen while less than 15% of that material should pass through a 1/16th inch screen (Harben, 1999). In the USA, metallurgical grade fluorspar needs to have over 60 effective % fluorspar ({%CaF_2 - [2.5 x %SiO_2] } > 60). Fines meeting or slightly exceeding chemical specifications of metallurgical grade products may be pelletized or briquetted and used as a substitute for the traditional "gravel-type" fluorspar products seen in several segments of the metallurgical industry (Figure 13).

While acid grade concentrate is considered by users as the highest quality product (> 97% CaF_2), it is commonly produced from lower grade ore than metallurgical grade concentrate. This is possible because acid-grade concentrate does not have to be coarse-grained (fine-grinding and flotation can be used for upgrading). To produce metallurgical grade ("gravel-type"), rather exceptional deposit is required, or the ore must be extracted by selective mining. To preserve coarse fluorite particles, the mine run is only crushed, sorted (sometimes by hand or upgraded using a heavy media separation circuit), screened, dedusted and dried before packing and shipping.

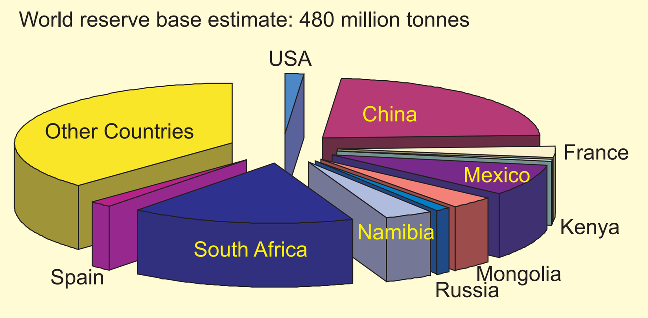

Figure 14 Geographic location of known fluorspar reserves (data reported by Miller 2008a).

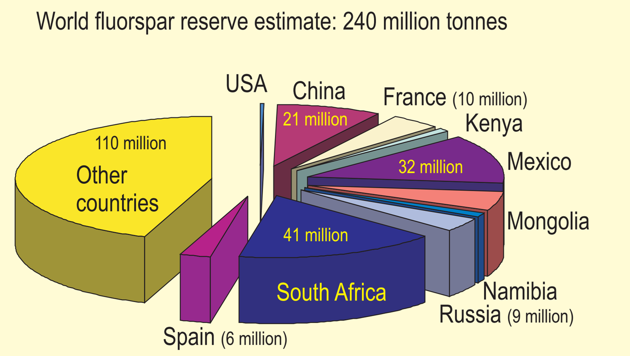

Figure 15 Geographic location of the fluorspar reserve base (as reported by Miller 2008a).

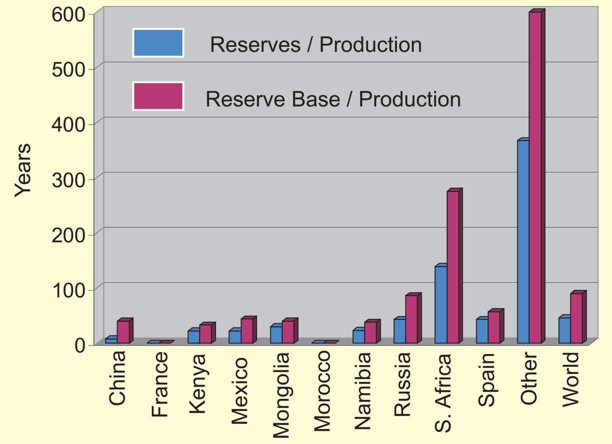

Figure 16 Ratios of "reserves" and "reserve base" to the 2007 yearly production can be used as crude relative indicators of fluorspar availability. The ratio involving reserves looks at near term availability and ratio involving reserve base provide longer term estimate. The accuracy and precision of these estimates are ultimately dependent on the quality of the database (in this case we use the reserves and reserve base data from Miller (2008a) and yearly productions as reported by Miller (2008b)).

Fluorspar Availability

The availability of fluorspar , based on a compilation of Miller (2008a) is summarized in Figures 14 and 15. Data probably incorporate a large margin of error (it is highly unlikely that world "reserves" are exactly 50% of the world "reserve base"). US Geological Survey (2008) definitions of the terms "resources", "reserves" and "reserve base" are defined below. The term "resource" refers to "a concentration of naturally occurring solid, liquid, or gaseous material in or on the Earth's crust in such form and amount that economic extraction of a commodity from the concentration is currently or potentially feasible".

The term "reserve base" refers to "an identified resource that meets specified minimum physical and chemical criteria related to current mining and production practices, including those for grade, quality, thickness, and depth. The reserve base is the in place demonstrated (measured plus indicated) resource from which reserves are estimated. It may encompass those parts of the resources that have a reasonable potential for becoming economically available within planning horizons beyond those that assume proven technology and current economics. The reserve base includes those resources that are currently economic (reserves), marginally economic (marginal reserves), and some of those that are currently sub-economic (subeconomic resources)".

"Reserves" are "a part of the reserve base which could be economically extracted or produced at the time of determination. The term reserves need not signify that extraction facilities are in place and operative. Reserves include only recoverable materials". South Africa stands out because its reserves and reserve base could sustain the 2007-level production (295 000 t/year) for 139 and 275 years respectively. Morocco is a major producer, yet Miller (2008a) does not have information regarding its fluorspar reserves or reserve base. Russia's reserves are described as "moderate". In the absence of better data we have extrapolated Russia's reserves to be half the size of its reserve base. Some other fluorspar producing countries listed by Miller (2008b), not shown on Figure 16 for similar reasons, are Brazil (63 700 t), Iran (65 000 t), UK (40 000 t) and Germany (53 000 t). The production data used in the calculations are from Miller (2008b). The gaps in the data, as illustrated by examples of Morocco, Russia and other remind us of semiquantitative aspect of this interpretation. Figure 16 shows the ratios of "reserves"/yearly fluorspar production and "reserve base"/yearly fluorspar production for major fluorspar producing countries. These ratios are crude short term and medium term indicators of in situ fluorspar availability. South Africa has the best potential to remain the major fluorspar producer over the short- and long-term. The ratio of reserves/yearly production for China is lower than for other major fluorspar producing countries. Totalitarian regimes traditionaly overestmated their reserves. Today, the inverse may be true. It is also possible that Chinese mines were high-graded during periods of low fluorspar prices. If the data is correct, assuming that there was no new exploration work going on in China, this country would have less than 8 years of reserves. France, a historical producer, discontinued fluorspar mining in 2006. All other producing countries appear to have enough reserves to last at least 20 years. Their reserve bases could sustain production at their 2007 levels for more than 30 years. Figure 16 is showing that there are over 367 and 600 years of supplies for the category "other" countries. This may potentially provide consumers with a false sense of security if they forget that these countries represented combined production of only 300 000 t of fluorspar in 2007. The last entry in Figure 16, identified as "world" provides a global picture. The ratios world reserves/world yearly production and world reserve base/world yearly production indicate that world reserves and resource base could sustain global world production of 5.31 million t of fluorspar/year for a period of 46 years and 90 years respectively. The geographic shift in fluorspar production from China to the rest of the world is also supported by economic changes. In the past, fluorspar producers in China, benefited from low energy and labour costs and were encouraged to export raw materials. is locatedThe advantages that made China a dominant fluorspar producer are disappearing. A large proportion of the fluorspar reserve base is outside of China (Figure 14), and high fluorspar prices may permit a restart of previously closed fluorspar mines and possibly development of new ones in Africa, North America and Europe. In the short term, China will remain a dominant fluorspar producer and consequently will be influencing fluorspar prices. The relation between supply and demand may not be entirely elastic and shortages in specific fluorspar products may develop. In developed countries it takes several years to bring a new mine into production. Discussion with representatives with current fluorspar producers from Mongolia and Brazil suggest that permitting procedure for a fluorspar mine in these countries take less than a year, therefore any fluorspar shortages are likely to be short-lived. The size of reported reserve base suggests that as long as fluorspar prices remain high, and the market is growing or stable, a number of new development projects could start. How many of these new projects will be successful depend on the future fluorspar market trends. The primary fluorspar projects with high (or at least above average) tonnage and grade, metallurgicaly simple ore, with sound technical financial backing and a strong management team linked to fluorspar consumers, will reach production stage and survive a major economic downturn. Availability of infrastructure and proximity to low transportation cost coridors or proximity to the market are other important considerations. Selected fluorite occurrences located in British Columbia (Figure 17) are described in the next section.

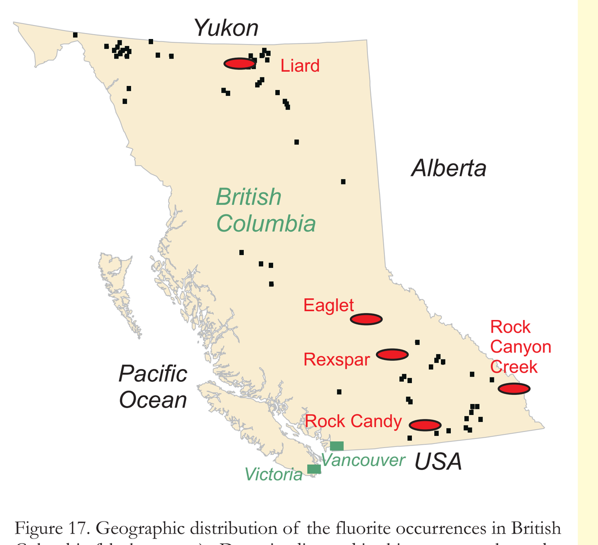

Figure 17. Geographic distribution of the fluorite occurrences in British Columbia (black squares). Deposits discussed in this paper are shown by red ellipses.

Fluorspar in British Columbia

There are over 78 fluorspar occurrences in British Columbia (Figure 17). Information regarding fluorite is summarized by Pell (1992) and in MINFILE <http://minfile.gov.bc.ca/searchbasic.aspx>. The BC Regional Geochemical Survey <http://webmap.em.gov.bc.ca/Mapplace/minpot/ex_assist.cfm> provides information regarding fluorine concentrations in water. Such data sets are extremely useful in the early stages of exploration for fluorite and variety of metallic deposits. Rock Candy (fluorite); Eaglet (fluorite ± molybdenum ± celestite [$Sr(SO_4)$]); Rexspar (fluorite± celestite), several occurrences in the Laird River district (fluorite ± witherite [$BaCO_3$], barytocalcite and barite) and Rock Canyon Creek (Fluorite ± Rare Earth Element [REE] ± precious metals) are described bellow.

Rock Candy Mine, in SE BC (Figure 17), produced 56,000 t of ore grading 68% CaF_2 and 22% SiO_2. Over 36,760 t of fluorite and 1,673 t of silica were shipped to Trail smelter. 12,300 t of broken ore may remain in stopes and 47,800 t of probable ore in pillars and sills adjacent to stoped areas. These historic estimates are not NI 43-101 compliant. The deposit consisted of a network of veins which vary from a few cm to 10 m in width and a breccia zone (Figure 5). Mineralization occupies a silicified, north-trending, fracture zone in Tertiary andesitic volcanics adjacent to a large syenite intrusion (Figure 18). Four m wide vein, consisted of massive fluorite was bounded on the west by 1.5 to 2 m of fluorite-matrix breccia and a thin composite banded margin adjacent to altered country rocks. It wa cut by vuggy quartz veins. The marginal breccia contains fragments of country rock in a matrix of fluorite, chalcedony, kaolin, pyrite, quartz and calcite. The banded western margin of the vein consists of barite with calcite, fluorite, chalcedony and quartz. Fluorite veinlets, 4 to 5 cm thick cut the altered host rocks. Historic drilling has shown intermittent fluorite mineralization to the north of the known mineralized zone. Fluorite vein (1 m wide) is exposed 1 km north of the main workings (Pell, 1992).

Rexspar property (Figure 17) is located 3.5 km south from the Birch Island railway station. Five uranium (U) zones and one fluorite deposit (Figure 19) are hosted by a 15 to 120 m thick trachyte unit consisting of intrusive porphyry and related tuff and breccia. The trachyte is underlain by quartz-sericite schist, chlorite schist and dacitic to andesitic volcanic breccia, with interlayers of grey phyllite, slate, chert and sericitic quartzite (Preto, 1978). Shearer (2007) summarizes all the available data. U mineralization in BC is considered as a restricted resource (as defined by USGS, 2008). Pre-National Instrument 43-101 resource estimates suggest that 1.4 million t of fluorite mineralization averaging 23.46% CaF_2 (cut-off 15% CaF_2) is potentially open pit-mineable (Descarreaux, 1986). If the fluorite mineralization is spatially distinct from U zones, as suggested by past investigations, it may have some development potential. If the fluorite mineralization contains appreciable U or Th concentrations, its the development potential could be affected by strong local opposition to U mining. McCammon (1950) indicates that fluorite-bearing rocks contain anomalous values of Y, La and Ce. Mo and Sr are also reported in anomalous concentrations. Presence of celestite ($Sr(SO_4)$) and bastnaesite ($(Ca, La, Y)CO_3F)$) may account for some of these.

Eaglet deposit (Figure 17), is located on the shore of Quesnel Lake. Mineralization occurs in an area of 1500 by 900 m, but little of it outcrops (Pell, 1992). Fluorite is hosted by quartz-feldspar-mica gneiss injected by pegmatite, aplite and granitic rocks. Chloritic, sericitic and potassic alteration with associated biotite and epidote is common in the mineralized area (Pell, 1992). The geology is summarized on Figure 20. Fluorite is disseminated in the country rock and in fracture fillings (from hairline to over 15 cm in width), or as masses 15 to 20 cm across. Galena, sphalerite, molybdenite, celestite, and pyrite are reported within fluorite-bearing area. Gangue minerals consist of feldspar, quartz, calcite, siderite, gypsum, dickite and allanite (Pell, 1992; Hora et al. 2008) with rutile, zircon, sphene, fluorapatite, magnetite and pyrochlore present as accessory minerals (Hora et al., 2008). Historical fluorite resource, pre-dating NI 43-101, is reported to be 24 million t grading 11.5% CaF_2 (Eaglet Mines Ltd. Annual Report 1984). According to Hora (2005), who reports on results of recent chemical analyses of drill core obtained during the 1980 to 1984 exploration programs, Mo is reported in a large number of samples, but independent of F, Sr, Pb, Cu and Zn concentrations. He also indicates that about 25% of Mo values are in the 0.001 - 0.02% range and that the dark purple fluorite is enriched in the Th and light REE relative to the green and colorless varieties. Recent press release put emphasis on Mo mineralization (Freeport, 2008) and appears in line with the internal Eaglet Mines Ltd. document from the early 1980's quoted by Hora (2008). The later indicates that fluorspar and saleable MoS_2 concentrates were obtained in pilot tests by Kamloops Research and Assay Laboratory Ltd.

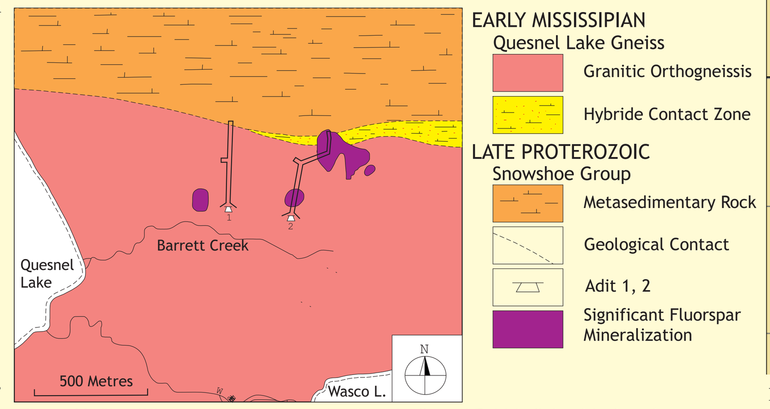

Figure 20. Simplified geology of the Eaglet deposit, Central British Columbia (based on Pell, 1992).

Liard district (Figure 17) extends for 17 km north from Liard Hot Springs Provincial Park (Figure 21). More than 20 fluorite occurrences are located along an irregular, breciated, probably unconformable contact (Woodcock, l972a) separating the Upper Devonian Besa River Formation (shale) from the Middle Devonian Dunedin Formation (limestone). Fluorite occurs as lens-shaped or irregular replacement bodies, veins and as cement in breccias. Most of occurrences are described by Woodcock and Smitheringale (1955); Woodcock (1972a), McCammon (1973) and Pell (1992). Results of metallurgical tests are provided in Woodcock (1972b). The Gem, Tam, Coral-Camp and Tee deposits are the main deposits. Tam and Coral-Camp are described bellow. **Tam** mineralization forms replacements and breccia cements in limestone and shale. Fluorite is accompanied by witherite ($BaCO_3$), barytocalcite ($(Ba,Ca)CO_3$) and barite ($BaSO_4$). Indicated and potential historical resource (not National Instrument 43-101 compliant)nof 500,000 t averaging 36.7% CaF_2 are reported by Mineral Policy Sector (Corporation Files:) suggest that follow-up may be justified. **The Coral-Camp** area consists of limestone breccia, cemented and/or replaced by fluorite, witherite, minor barite and barytocalcite. At the main showings, diamond drilling intersected 26.5 m of 39**%** CaF_2 (Woodcock, 1972a). Several 3-metre long channel samples assayed up to 88**%** fluorite and a bulk sample assayed at 64.88% CaF_2 (Woodcock, 1972b; McCammon, 1973).

Rock Canyon Creek deposit, is located 50 km east of Canal Flats, (Figure 17). The deposit is interpreted as a stratabound, 3.5 km long belt of fluorspar/rare-earth mineralization, exposed in five mineralized zones and hosted mainly by dolomite and limestone ("basal Devonian unit" on Figure 22). The main type of fluorite mineralization consists of disseminations and veinlets of dark purple fluorite in a carbonate matrix (Figure 6). Ce, La and Nd are present in anomalous concentrations (Hora and Kwong, 1986). Bastnaesite, pyrite, gorceixite, calcite, limonite, illite, barite, parisite, apatite were reported as minor constituents by Pell (1992) and Hora and Kwong (1986). Follow up studies did not confirm gorceixite and bastanaesite but suggest that synchysite and goyazite are present (Graf, undated; Sampson et. al., 2003). Fluorite content varies from 2 to more than 10% of the rock but most high grades came from samples that were not found in situ (Pell (1992). One sample from vein-type mineralization assayed 201 gr/t Ag and 0.8 g/t Au (Graf, undated). Subsequent electron microprobe studies suggest that Ag occurs in the form of tellurides (Graf, undated). Based on the coexistence of fluorite with REE mineralization, this deposit was interpreted as carbonatite- or a deep-seated alkaline intrusion- related deposit (Pell and Hora (1987). Most of the trenches are collapsed and heavily overgrown. The owner of the property is convinced that the next stage of the exploration should consist of drilling and sampling of the main zone as potential source of REE and fluorite.

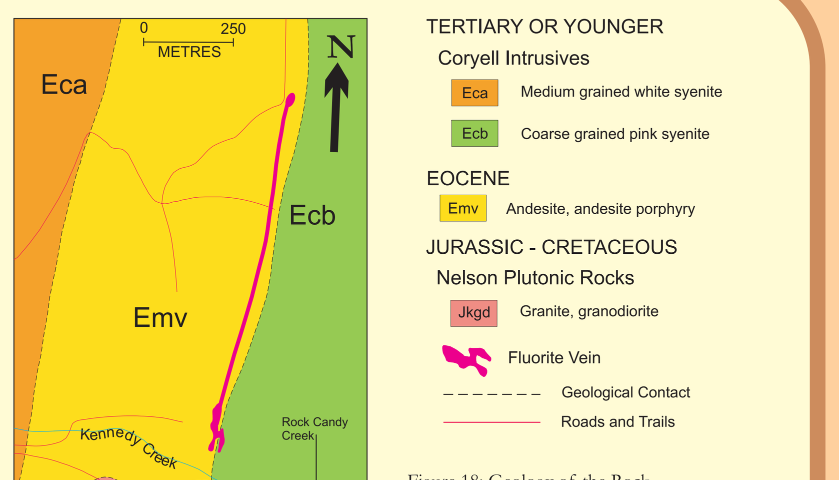

Figure 18: Geology of the Rock Candy Mine. (after Pell, 1992).

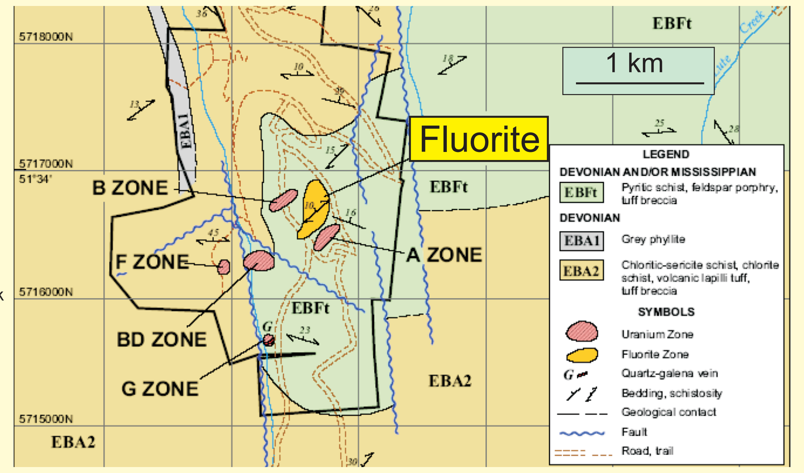

Figure 19. Geology of the Rexspar Mine (modified from Shearer, 2007).

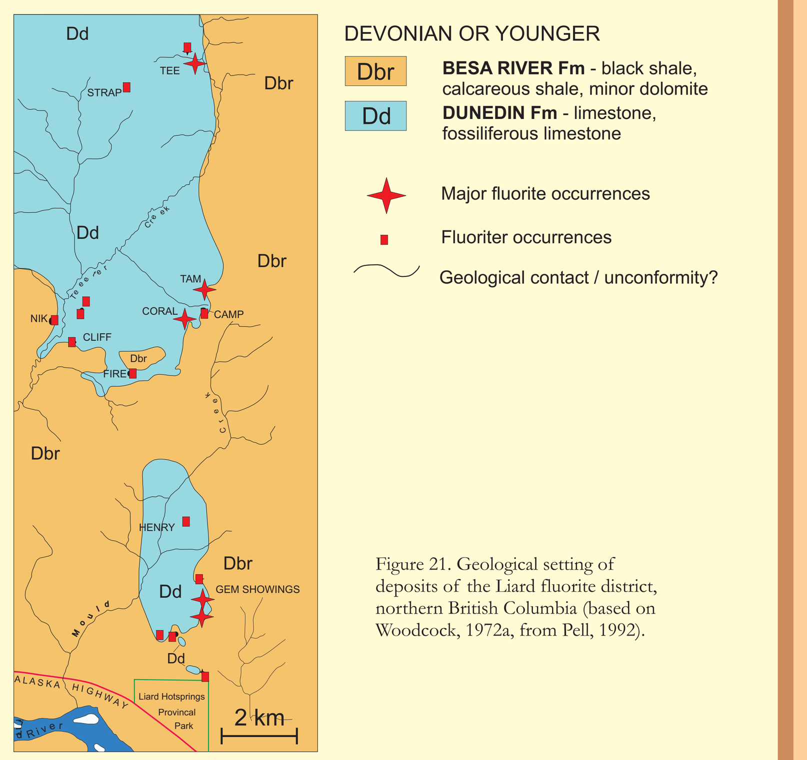

Figure 21. Geological setting of deposits of the Liard fluorite district, northern British Columbia (based on Woodcock, 1972a, from Pell, 1992).

Summary

The nomenclature and regulations used for reporting of ore reserves, resources in many of the developing countries do not follow the same standards as in western countries and are not comparable to those of Canadian National Instrument 43-101. Consequently, legitimate concerns may be raised regarding ore reserve estimates from developing and controlled-market countries.

Assuming that world reserve and resource base data compiled by Miller (2008a) is reasonably accurate, there should be no long term in situ shortage of fluorspar . This is a reasonable assumption, unless the balance between supply and demand is affected by new technology requiring fluorite or fluorine, or unexpected conflicts or upheavals impact major fluorspar producing countries. Mexico, South Africa, Mongolia and other countries (including Canada) with known fluorite deposits will step in if reductions in China's fluorspar production persist. Acid grade concentrate, derived from variety of primary fluorspar deposits or recovered as byproduct of metal mining, accounts for the bulk of the fluorspar market. Environmental pressures on the fertilizer industry will moderate long term growth in fluorspar demand through increased recovery of F from phosphate rocks may to some extent reduce needs for acid grade fluorspar concentrate.

New deposits containing ores amenable to production of metallurgical grade fluorspar, which is characterized by larger particle size, are more difficult to find. British Columbia has an excellent geplogical potential to host world-class fluorite-bearing deposits. Rock Candy, Rexspar, Eaglet, Rock Canyon Creek and the Liard area deposits are examples of florspar resources available in British Columbia.

Acknowledgements

Appreciation is extended to Mr. Hector Valle Martin, the Director General / C.E.O of MEXICHEM in Mexico, Mr. Denis Cook of the Vergenoeg Mining Company (PTY) Ltd. in South Africa for the permission to use their photographs. The author was assisted in the field by Alan Duffy, a graduate from the Trinity College, Ireland. Field collaboration with Chris Graff of the Spectrum Mining Co. and Bob Jackson owner of the Rock Candy Mine was greatly appreciated.

References:

For more information or for references cited in this document please contact: George.Simandl@gov.bc.ca; or gsimandl@uvic.ca

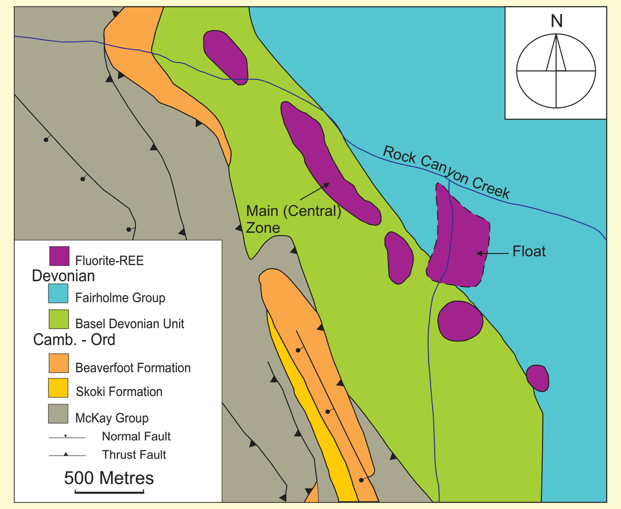

Figure 22. Geology of the Rock Canyon Creek fluorite REE ± precious metal feposit (from Pell, 1992).