The applicability and use of portable X-ray fluorescence (pXRF) and Infrared spectrometers (pIR-Spec) in mineral exploration

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pXRF – chemical analysis using the Olympus Innov-X Delta XRF

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Focused on gold and silver discovery

XRF (X-ray fluorescence) is a non-destructive analytical technique used to determine the elemental composition of materials. XRF analysis can determine the presence and concentration of a range of metallic and non-metallic elements by measuring the fluorescent, secondary, X-rays emitted from a sample when it is excited by X-rays. Each element present in a sample produces a set of characteristic fluorescent X-rays ("a fingerprint") unique to the specific element. The strength of the emitted characteristic fluorescence can be used to determine concentration of that element in the sample.

Energy dispersive XRF (EDXRF) technology analyses groups of elements simultaneously and is used in portable, hand-held devices. The portable XRF (pXRF) is a hand-held tool that uses this technique for rapid, preliminary field measurement of a range of elements such as pathfinders suites for epithermal (As, Ag, Sb, Ba, Hg, Tl) and base metals (Cu, Pb, Zn, Mo) mineralization. Presently, the pXRF cannot measure low-level gold concentrations, so the use of pathfinders is important. The pXRF is an invaluable modern exploration tool used to provide rapid elemental analysis assisting field geologist make informed in field exploration decisions.

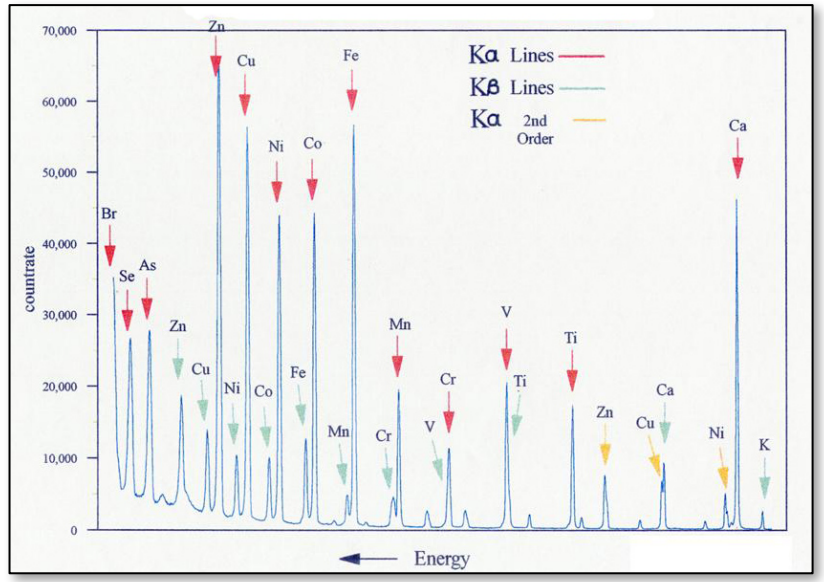
In its field programs, Mirasol Resources utilizes a pXRF manufactured by Olympus, the Innov-X Delta XRF.

Limits of Detection - Delta Premium, 3- Beam Soil Ta/Au Tube, SDD

Element of interest	**Cu**	**Pb**	**Zn**	**Mo**	**Ag**	**As**	**Sb**	**Ba**	**Hg**	**Tl**	**P**	**S**	**Cl**	**K**	**Ca**
Limit of Detection (ppm)	5 - 7	2 - 4	3 - 5	1	6 - 8	1 - 3	12 - 15	10 - 20	2 - 4	2 - 4	500 - 700	100 - 250	60 - 100	30 - 50	20 - 30
Element of interest	**Ti**	**Cr**	**V**	**Mn**	**Fe**	**Co**	**Ni**	**Ga**	**Se**	**Br**	**Rb**	**Sr**	**Zr**	**Cd**	**Sn**
Limit of Detection (ppm)	7 - 15	5 - 10	7 - 15	3 - 5	5	10 - 20	10 - 20	3 - 5	1 - 3	1 - 3	1	1	1	6 - 8	11 - 15

Modified from **Delta Handheld XRF: Limit of Detection ,2017, https://innovx.ca/PDF_LIBRARY.html**

From **pXRF Application Notes, 2017, www.olympus-ims.com/en/applications/field-portable-xrf-shale-gas/**



From **Wikipedia: X-Ray Fluorescence:2017, https://commons.wikimedia.org/wiki/File:XRFScan.jpg**

pIR-Spec – mineral mapping using Spectral Evolution PSM-3500

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Infrared Spectrometry (IR-spec) is an analytical technique used to determine the mineral species, mineral composition and crystallinity of some common clay, carbonate and sulphate minerals present in rock samples. This technology measures the wavelengths of infrared light absorbed by the different chemical bonds to identify minerals present in a sample.

Each of the target minerals has a characteristic IR absorption pattern that can be used to identify the mineral species, chemical variations and degree of crystallinity of minerals. Characteristics important in mineral exploration, such as the pH and temperature of formation of a rock sample, can be determined from the assemblage of alteration minerals (alteration facies) present in an altered rock, the chemistry of the minerals and their degree of crystallinity. When this information is used in combination with alteration mapping and ore deposits zonation models, it can assist the field geologist to interpret the style of mineral system present, and can provide mappable vectors toward zones that may host higher grades of the target commodity. Mirasol field teams use this technique around the world to map alteration facies, which are subtle mineralogical and crystallinity changes that have provided vectors to mineralization in large, complex alteration systems.

Mirasol Resources utilises the IR-spec alteration mineral analysis expertise of Australian-based consultancy (Global Ore Discovery) who have developed IR spectral algorithms which take advantage of the high-resolution absorption features contained in data collected from modern portable IR Spectrometers (pIR-Spec) such as its PSM-3500, a field portable that is made by Spectral Evolution.

Common IR Absorption Features