

Analytical instrument for scientific XRF core scanning

Now with much improved XRF!



ITRAX XRF CORESCANNER

COX
Analytical Systems

Some useful Itrax Corescanner features:

- Itrax is a XRF scanner for split sediment cores, drill cores and other flat samples
- Itrax offers XRF multi-element analysis of all elements from Al to U in one analysis
- The XRF can determine elements down to the PPM level for most metals
- It is often enough with 1 second measuring time per point for satisfactory data quality
- The included digital radiography adds another dimension to the data interpretation
- The scanning, digital RGB line camera provides excellent sample images
- Itrax can scan one meter of core in two minutes with XRF good data quality
- Scans are performed with any step size from centimeter down to 0.1 millimeter
- Itrax features the same excellent XRF performance regardless of scan resolution
- The XRF analyzes are performed non-destructively and without sample contact

Radiographic information is a good complement to XRF

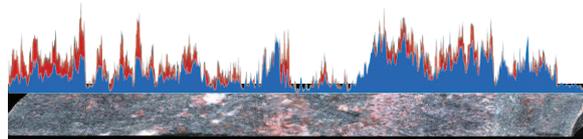
Radiographic images can help in verifying whether an XRF peak is to be interpreted as a e.g. a grain or a layer. The x-ray images show distribution of structures based on density and/or chemical variation that often is invisible to the eye and optical camera.

The integration of radiography and XRF into a single instrument guarantees that radiographic

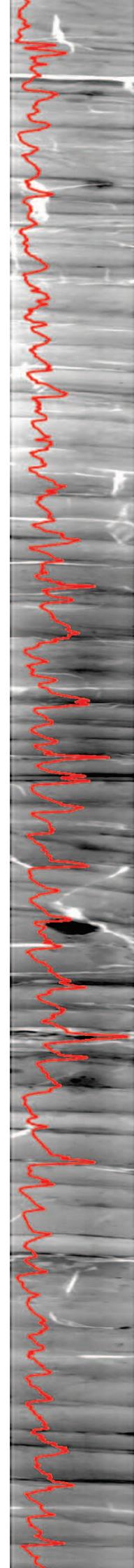
data match the positioning of XRF. This matching is often critical, for instance to reveal migration of elements in relation to sedimentary layers. Combined XRF and radiographic data is exemplified in the image in the center of this page (*Ca concentration profile overlaid on a magnified radiographic image of a lake sediment section*).

Detailed information when required

The Itrax can determine the distribution of a wide range of elements at any analytical resolution from the centimeter scale and down to 0.1 millimeter. This makes it possible to accurately measure fine details with high precision, when needed. Since only 1-3 seconds per analytical point is required to register a wide range of elements, highly detailed scans of long core sections can be performed in reasonable time. Regardless of chosen step size, every part along a sample is scanned, to include all information.



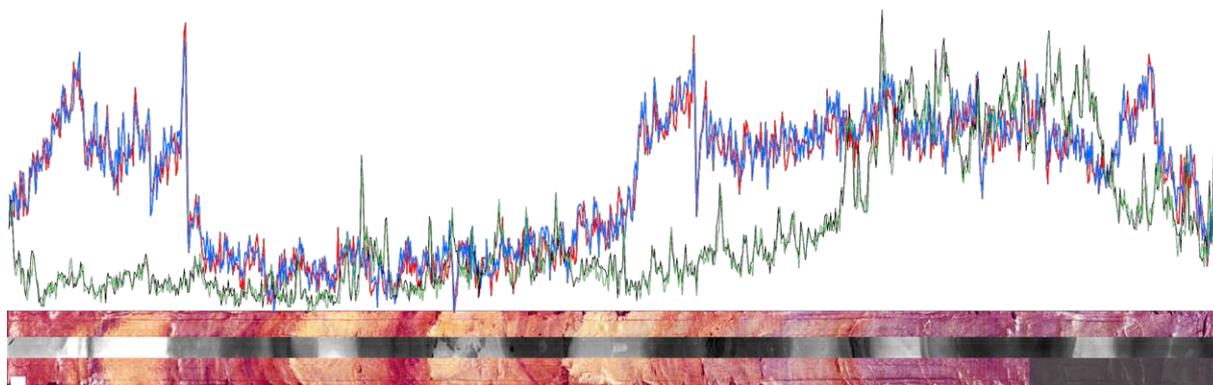
This 27 cm long drill core was analyzed using 0.2 mm steps. Data like these can be obtained in 1 sec counting time per point. One Zirconium profile (blue) and one Lanthanum profile (red), each with 135 data points, are shown as examples. The Zr and La average 0.9% and 0.2%, respectively. The sample was kindly provided by Tasman Metals. Please note the information detail.



Quality XRF analysis now in one second per point

The latest version of Itrax can scan as fast as only one second per analytical point with good data quality. Centimeter or millimeter scale makes no difference, so really fast sample overview scans as well as high detail scans can now be performed. This is demonstrated in the XRF

graphs below. The time for analysis at each point is equally short at low or high analytical resolution, making this instrument very time efficient regardless of selected analytical step size. The step size and the exposed area have the same size, so the whole sample length is always covered.



Itrax optical image, radiographic image and XRF data from an Arctic sediment core

At the bottom of the image above is a photo of a 600 millimeter long section of a wet arctic sediment core, captured with the Itrax camera. The photo has been contrast enhanced to show more details, applying built-in software features. In the lower right corner of the core photo is pasted a small section of the sample as seen by eye before contrast enhancement. In the central part along the photo is shown a radiographic image of the sample. The radiographic image shows details that are not visible in the optical photo. Above the photo is shown four graphs from the XRF scan of the sample, showing the variation in concentration along the sample section, revealing still more details about the sample. The red and the blue graphs show

Silica distribution from two consecutive scans, respectively. The green and the black graphs show the two Manganese profiles from the same XRF scan. The measuring time was 1 second at each position, with an analytical step and beam size of 0.2 millimeter. Please note the good correspondence between the two profiles for each element, in spite of the short measuring time. Precision can be further improved by extending the time for analysis. The average Silica concentration was approximately 10%, while the Manganese was 0.07% on average. This core material was sampled at 4228 meters depth off Greenland, during the LOMROG II expedition 2012. Sample with courtesy of Dr. Richard Gyllencreutz, Stockholm University.

XRF scanning can provide many useful proxies

Itrax XRF Corescanner has been used for analysis of marine as well as lake sediments since 2003. During this time many of the users have published findings where element ratios are good indicators for a long list of events as mirrored in sediments and sedimentary rock. A few examples

of these are: Mo/Al as oxygenation proxy, Ba/Al, Ni/Al and Cd/Al as productivity proxies, V/Al as proxy for sulfidation processes, Ca/Fe indicative for biogenic carbonates, and the Ca/Sr ratio as proxy for detrital carbonates. The list is long and growing.

Some Itrax features

Itrax offers multi element analysis for determination of all chemical elements from Al (Mg) and heavier, by scanning micro XRF (X-ray Fluorescence). The X-ray beam size is 20x0.2 or 20x0.1 millimeter, with 0.2/0.1 mm in the sample length direction. Variable step-size with full cover of any step size is achieved by scanning along each step of the sample with the beam while measuring.

The XRF system offers identification of light as well as heavy elements, including difficult elements like REE, and overlapping elements like Ti/Ba. The XRF performance of this instrument has improved much over the years and now, the standard count rate net throughput is ~100,000 cps (counts per second). The maximum throughput is 10⁶ cps. With optional equipment the standard count rate can be boosted up to 300,000 cps, for users with a need for very high sample throughput. The high number of counts per second allows for fast as well as precise analyses in short time. Usually 1-5 seconds is used per analytical point.

Light element analysis enhancement by (helium-free) vacuum system for high sensitivity, contact free analysis, and lowest running cost.

The Itrax digital x-ray radiography features 16 bit image format and variable lateral resolution down to 25x20 micrometers pixels. The radiographic image width is ~20 millimeters. Sample variations in density and chemistry as small as ~1%, can be detected. Sample thickness limitations apply, and are depending on the matrix composition.

The X-ray source is a 2200 W/60 kV high power X-ray tube with Cr anode as standard (also Rh and Mo are available). Time to switch tube is about 10 minutes. Low cost x-ray tube with 3-5.000 hours expected life time.

The digital RGB line camera is equipped with 3x2000 pixels, 3x16 bit RGB high color definition and 50 micrometers pixel size. Built in pixel binning facilitates lower resolution. The camera offers up to 500 true levels per color channel. A digital contrast enhancement post processing tool can be applied for improved image detail visibility. The included crossed polarizing filters minimize glare effects on wet surfaces.

XRF, radiographic, and optical measurements are non-destructive and are performed without contact to the sample surface. The sample surface height profile is measured along the sample, and adjusted for during analysis. This allows for flat samples as well as samples with somewhat varying height to be analyzed with good results. Magnetic susceptibility measurement (optional equipment) is done in contact with the sample surface.

Measurements can be done with, or without, a plastic film covering the sample surface. Applying a film is useful during extensive analyses.

The maximum core length is up to 1.75 meters as standard.

Sample thickness range is 22-56 millimeters as standard. For split sediment cores it is 30-60 millimeters thickness, i.e. 60-120 millimeters full circle as standard. A modified Itrax that accepts split cores with diameters up to 150 mm can be supplied on request. Slabs and U-channels, wood samples, and flat, or almost flat, sample types can also be analyzed. An U-channel holder is available.

Scan time: Normal scan time per point is 1-5 seconds, to detect 15-20 elements in sediments. Down to ~0.5 s/point applies for radiography, and down to 1 s/point for XRF, plus an overhead time of ~0.2 second per point.

Software: Itrax Navigator software for instrument operation uses an intuitive graphical user interface. This software applies a scientist's approach where most analytical parameters can be adjusted by the user. Sets of analytical parameters can be stored and re-called for fast set-up of standardized analyses. XRF raw data are stored as spectra from each point of analysis. Element data are available as peak areas as well as concentrations of each element. Data can be exported to e.g. Excel. Itrax is equipped with software for calibration based on standards. Software for quantitative measurements on very variable samples, like e.g. mineral cores is available as an add-on. The ReDiCore software for data display and evaluation greatly simplifies data interpretation by presentation of images, radiographic information, XRF data etc together. Image and graph production is made easy by a copy-and-paste function that delivers copied material straight into software like MS Word and Excel.

Itrax is delivered with a one year warranty including Internet support.

The Itrax Core Scanner dimensions are ~4500x820x1570 millimeters LxWxH with a weight of about 1100 kilos. Different powering voltages and frequencies can be applied on request.

The Itrax is a complete plug-and-play delivery with all that you need, including hardware and software, computers, training, Internet support in English and Chinese, etc.

The instrument fulfils radiation safety requirements, and it is completely safe to work close to the instrument without limitations.

Add-on equipment

Available optional equipment include but are not limited to: A boosted XRF system ~300,000 counts per second net throughput for users that require the highest sample throughput and data quality, an XRF system with a beam size of 0.1 millimeter without need for extended time for analysis, x-ray tubes with different anode materials for adaptation of the element sensitivity profile to different applications, magnetic susceptibility sensor Bartington MS2E type, "standard free" quantitative software, and container installations.

Detection limits

Element	Cr tube (ppm)	Rh tube (ppm)
Mg	8000	-
Al	1300	8000
Si	300	2000
P	100	890
S	47	245
Cl	27	112
K	9	36
Ca	6	24
Ti	3	14
Mn	130	7
Fe	25	7
Br	12	5
Sr	15	5
Ba	20	43
Pb	24	13

The detection limits of the Itrax corescanner are highly competitive. A great advantage for high resolution work is that they apply regardless of selected lateral resolution, from centimeter steps and all the way down to highest lateral resolution of 0.2 or 0.1 millimeter. The elements that can be detected range from Mg/Al and all the way up to U (Uranium). This list contains only a short selection of elements, but please contact us for a complete list if you are interested in other elements. The values are all based on a 100 second analysis and refer to a clay matrix. Detection limits for two different x-ray tubes are listed, where Cr is the standard tube and the Rh tube applies when analysis of heavier elements like e.g. Mo are in focus. All elements listed are determined simultaneously and in one analysis for each tube type, without further restrictions, changes or special settings. The elements that are most commonly detected in an unpolluted, clay based sediment sample are (Mg) Al, Si, S, Cl, K, Ca, Ti, Cr, Mn, Fe, Ni, Cu, Zn, Br, Rb, Sr, Zr, Mo, Ba, and Pb.

Cox Analytical Systems

Östergårdsgatan 7, S-43153 Mölndal, Sweden
www.coxsys.se, info@coxsys.se phone +46 31 708 3660

