

INSTRUMENTAL ANALYSIS IN GEOLOGY
BY HAMDAN N. S.

PROBLEMS & SUMMARY

One of these elements Can't be detected by XRF

1. **Carbon**
2. Potassium
3. Iron
4. Calcium

XRD is a method used to identify substances due to:

1. chemical composition
2. **Structure**
3. magnetic properties
4. Density

Device separate equal λ of different elements in AAS

1. detector
2. nebulizer
3. burner
4. **Monochromator**

A wave phenomenon in which the apparent bending & spreading of waves when they meet an obstruction

1. Reflection
2. Refraction
3. **Diffraction**
4. Interference

Minerals that slightly repelled by a magnetic field:

1. paramagnetic
2. **diamagnetic**
3. Ferromagnetic

Minerals that slightly attracted by a magnetic field:

1. **paramagnetic**
2. diamagnetic
3. ferromagnetic

Quartz & feldspars are separated from minerals with higher density by using heavy liquids such as:

1. **bromoform**
2. Iodoform
3. acetone
4. Ethanol

Staining for granites is done by using sodium cobalt nitrite, alkali-feldspar color changes into:

1. Red
2. **Yellow**
3. White
4. Orange

In X-ray tube anode made of these metals except:

1. Copper (Cu)
2. Tungsten (W)
3. Rhodium (Rh)
4. **Al**

Hint. Heavy metal with high melting point
Platinum, Tungsten

The standard thin section of rocks thickness

1. 0.3mm
2. 0.003mm
3. **0.03mm**
4. 3.0mm

Materials containing a known concentration & used to build calibration curve in instrument analysis

1. Chemicals
2. Buffer
3. **Standard**
4. Indicator

Method to distinguish between amorphous & crystalline silica? 2 techniques

1. **XRD**: can detect crystalline compounds \rightarrow SiO₂
2. **XRF**: amorphous (Si & O atoms concentration)

Before magnetic separation of minerals, sample are treated by hand magnet. Why? will clog the Frantz separator (instrument used to separate minerals)

Function of the crystal in Spectrometers of XRF?

عندما تصطدم ال primary X-ray بالعينة يخرج منها احد الالكترونات ويحل مكانه e من مستوى طاقة اعلى، وفرق الطاقة بين المستويين يُنتج على هيئة XRF ولان لكل عنصر له characteristic X-ray فان كل λ للأشعة المنبعثة يحدث له تداخل وانعكاس عند θ معينة، اذا تم عكس هذه الأشعة مباشرة لل detector ستكون نسبة الخطأ كبيرة لذا يتم تمريرها ل crystal تتميز باحتوائها **constant d spacing** وتتحرك بحركة دائرية، وحركتها هذه تعمل على فصل ال x-ray المختلفة بحيث يتمكن ال detector من قياسها كل على حدى (لأنها تدور فعد كل θ بمحيط دورانها **تعكس λ محدد** لعنصر محدد وعندما تتحرك تتغير θ فتعكس λ لعنصر اخر وباقي الاطول يحدث لها تداخل هدام...)

How would you know that thin sections are still thick?

Using microscopic

Give names of essential materials & machines needed to make thin section?

1. **Glass slides, Cover slip, & Epoxy**
2. **Diamond saw (cutting machine for rock slab)**
3. **Coarse, medium, & fine carbide grit powder (400, 800, & 1200) to polished rock slab**
4. **Automatic grinding machine for polishing**
5. **Lap for grinding & a small warming plate**
6. **Microscope (To ensure the accuracy)**
7. **Hot plat (Electric gas)**

What is the Diffraction: **wave phenomenon in which the apparent bending & spreading of waves as they meet an obstruction, can be occurs with EMW such as light & radio waves, & in sound & water waves**

What is the difference between coating & covering?
The coating is just a thin cover on the sample to keep the details clear

Why minerals show several characteristics peaks on the diffractograph? **The diffracted beam (reflection) from any set of lattice planes can only occur at particular angles (2θ) predicted by the Bragg law**

Instruments used to distinguish among isotopes of an element **TIMS XRF, TIMS & SIMS**

Instrument used to distinguish ions of the same element in different valence states **wet chemical analysis or Mossbauer spectroscopy**

X ray cannot analysis atoms with atomic number $Z < 11$ why? **Larger atoms have greater energy differences between orbitals (energy level more closely matches the energy of photon), & in Smaller the electron orbitals are separated by low jumps in energy, are less likely to absorb X-ray photons**

SEM magnification 1000,000 times LM why? **Because Resolution limited by λ (LM work with VL)**

In contrast to visible light electron rays can give images with magnification up to 600.000X, why? **Because it's works with x-ray λ**

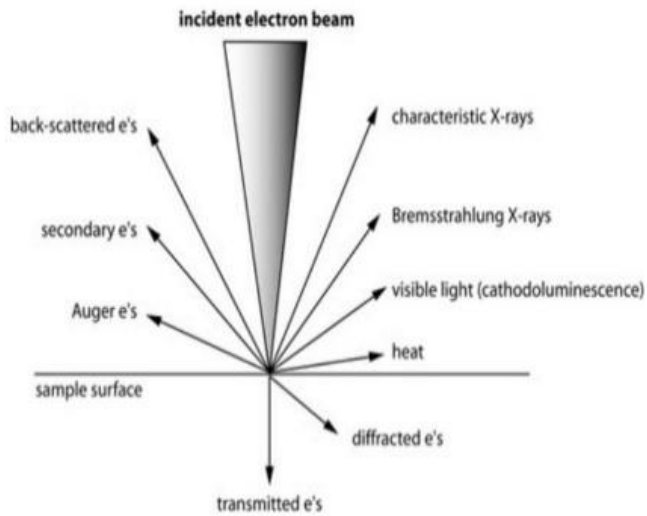
In SEM samples coated by gold, while for chemical analysis EPMA samples coated by carbon, Why?

الذهب اكثر قدرة لانتاج secondary ray لصنع صورة imaging يستخدم الكربون لانه خفيف ($Z < 11$) ولانه موصل للتيار الكهربائي ولو كان عنصر اقل سيحدث له تحليل وليس للعينة

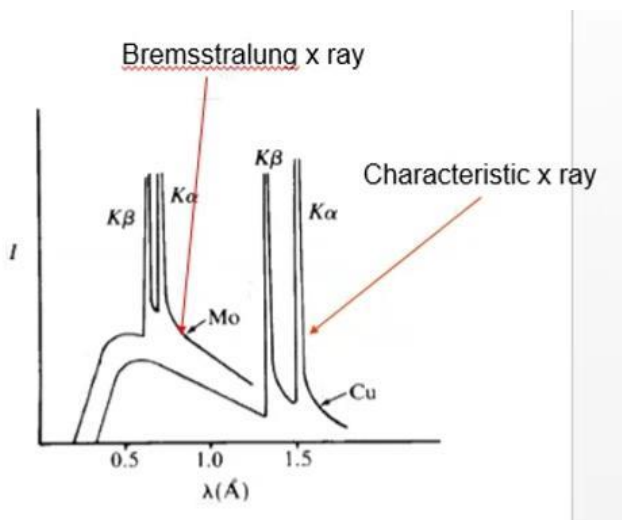
Difference between quantitative & qualitative analysis? **Quantitative is the amount (concentration) of an atoms & qualitative is the type (e.g. Minerals, Crystals) of a given materials**

Explain why x-rays no other type used to identify crystalline substrate? **الطول الموجي للأشعة السينية يتناسب مع المسافات بين المدارات**

Diagram represents the interaction between radiation & λ



Schematic diagram showing the X-ray emission spectrum of a heavy element



- **Quantitative analysis (amount of an atoms):** Microprobe analysis or Electron probe microanalyzer (EPMA), Atomic Absorption Spectroscopy (AAS), XRF
- **Qualitative analysis (crystal structure):** Atomic Absorption Spectroscopy (AAS), or XRD