

HOW CAN I BE CERTAIN THAT MY GOLD OBJECT IS AN ANTIQUE? CAN WE ANALYZE IT THE SAME WAY AS COPPER ALLOYS?

UNLUCKY, GOLD IS LESS SUBJECT TO WEATHERING AND SO, THE ALTERATIONS WE MAY OBSERVE ARE SUPERFICIALS...

MICROANALYSIS (WHEN USEABLE A GOLD OBJECT CANNOT ALWAYS BE SUBJECT TO SAMPLING), IS QUITE OFTEN INSUFFICIENT TO VALIDATE THE ANTIQUITY OF AN OBJECT...

THE CONTRIBUTIONS OF THIS TECHNIQUE WILL FOCUS ON THE DETECTION OF CLUES CHARACTERISTIC OF A MODERN METALLURGY OR THE USE OF ACIDS TO SIMULATE THE WEATHERING OF THE SURFACE...

IN ORDER TO COLLECT INFORMATION ON THE ANTIQUITY OF GOLD, WE STUDY ITS CHEMICAL COMPOSITION, MEANING THE MAJOR ELEMENTS MINORS AND TRACES THAT IT CONTAINS...

IN PARTICULAR, THE SEARCH FOR TRACE ELEMENTS (INCLUDING THE CONCENTRATION IS LESS THAN 0.1%) ALLOWS TO DETERMINE WHETHER THE METAL COMES FROM METHODS OF EXTRACTION ANTIQUE OR MODERN.

FOR THEIR DETECTION, WE USE DETECTION TECHNIQUES WITH A LOWER THRESHOLD THAN SEM-EDS, SUCH AS PIXE AND ICP-MS.

PIXE IS TO SEND ON THE OBJECT THE SCOPE OF PROTON BEAM WITH AN ENERGY HIGH ENOUGH TO CAUSE XRAY FLUORESCENCE, WHICH INFORMS US OF THE CHEMICAL ELEMENTS CONTAINED IN THE GOLD.

THIS TECHNIQUE REQUIRES A PARTICLE ACCELERATOR! HOWEVER IT IS USED WITHOUT SAMPLING THE OBJECT!

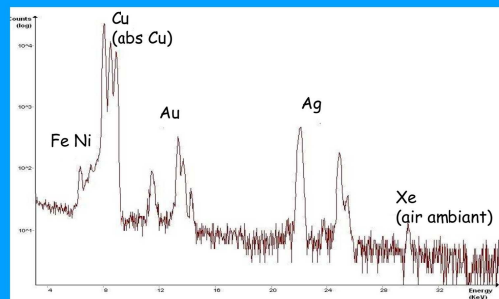
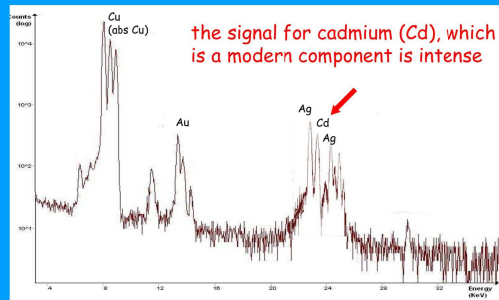
CONTRARY TO THE ICP-MS, WHICH REQUIRES SAMPLING A FEW DOZENS OF MILLIGRAMS WHICH ARE DISSOLVED THEN VAPORIZED (TRANSFORMED IN PLASMA) BEFORE BEING EXAMINED BY MASS SPECTROMETER.

THIS METHOD HAS THE BENEFIT OF THE GAIN OF RESULTS MORE PRECISE THAN BY PIXE, WITH AN EVEN LOWER DETECTION THRESHOLD THAT ALLOWS ACCESS TO AN HIGHER NUMBER OF CHEMICAL ELEMENTS.

THE GOLD ELEMENTAL COMPOSITION BEING KNOWN, WE CAN KNOW WHETHER IT IS COMPATIBLE OR NOT WITH AN OLD METALLURGY.

IN THIS FIRST CASE, WE FIND FEW TRACE ELEMENTS AND WE DETECT TYPICAL CLUES OF A MODERN EXTRACTION. THE ELEMENTAL COMPOSITION OF THIS GOLD IS INCONSISTENT WITH ONE OF AN OLD METALLURGY.

IN THIS SECOND CASE THE MATERIAL IS LESS PURE; THERE ARE MANY TRACES ELEMENTS BUT NO FORMAL INDICATORS OF MODERN EXTRACTION. THE ELEMENTAL COMPOSITION IS COMPATIBLE WITH AN OLD METALLURGY.



THIS METHOD BRINGS ANSWERS, BUT HAS ITS LIMITS...

FOR EXAMPLE, THE LACK OF MODERN ELEMENT AND THE RELATIVE PURITY OF THE GOLD ARE NOT A GARANTY OF THE ANTIQUITY OF THE MATERIAL...

SO IF I WAS TO MELT AND OLD PIECE OF GOLD TO CREATE A FORGERY THERE WOULD BE NO WAY TO DISCOVER IT?

NOT THROUGH THE ANALYSIS OF ITS CHEMICAL COMPOSITION, BUT THERE IS A TECHNIQUE TO DETERMINE THE ANTIQUITY OF THE LAST MELTING OF THE GOLD, HELIUM DATING!

HELIUM DATING?
HOW DOES IT WORK?!

THIS IS HOW IT WORKS: HELIUM IS GENERATED IN THE FORM OF GAS BY RADIOELEMENTS PRESENT NATURALLY IN OR (URANIUM AND THORIUM, ...). PRISONER OF COLD AND SOLID GOLD, HELIUM EVAPORATES WHEN THE METAL MELTS. AFTER THE GOLD HAS COOLED DOWN, NEW HELIUM ATOMS ARE FORMED AND ACCUMULATE IN THE MATERIAL ...

MEASURING ITS CONCENTRATION AND THE CONTENT OF RADIOACTIVE ELEMENTS PARENTS ALLOWS US TO KNOW THE ANTIQUITY OF THE LAST MELTING OF THE METAL USED IN THE MANUFACTURE OF THE OBJECT.

HOW SO?

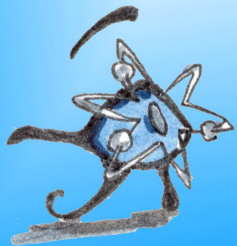
WELL, THE RADIOELEMENTS PRESENT IN GOLD DECAY NATURALLY IN ATOMS WHICH ARE THEMSELVES RADIOACTIVE AND SO DECAY, ... DURING THIS PROCESS CHAIN, CORES HELIUM (He) DEVELOP.



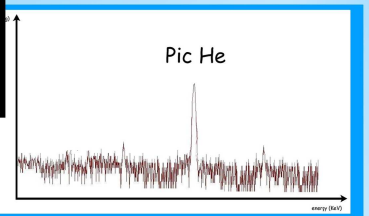
KNOWING ALL THE LINKS OF THIS CHAIN, TOGETHER WITH THEIR PERIODE OF DECAY, WE CAN DEDUCT THE QUANTITY OF He ATOMS FORMED EACH YEAR.

HOWEVER, EVEN IN ANTIQUE GOLD, He'S CONTENT IS VERY LOW! THIS MEANS SIGNIFICANT UNCERTAINTIES IN THE MEASUREMENTS WHICH LEAD SOMETIMES TO DIFFCULTIES IN THE RESULTS' INTERPRETATION...

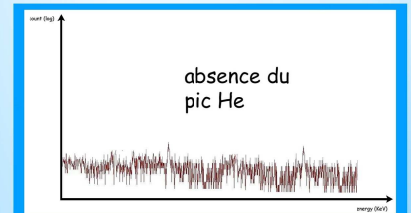
IT REMAINS THAT WE EXPECT TO FIND HIGHER He CONTENT FOR ANTIQUE GOLDS THAN FOR GOLDS MELTED MORE RECENTLY.



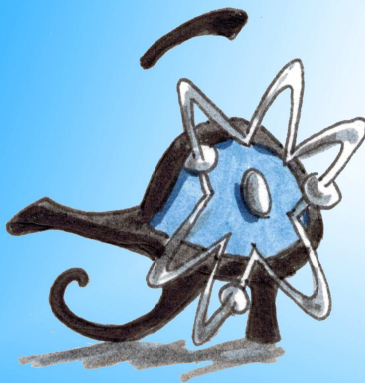
WHEN He IS PRESENT IN MEASURABLE CONCENTRATION, GOLD'S MELTING IS ANTIQUE,...



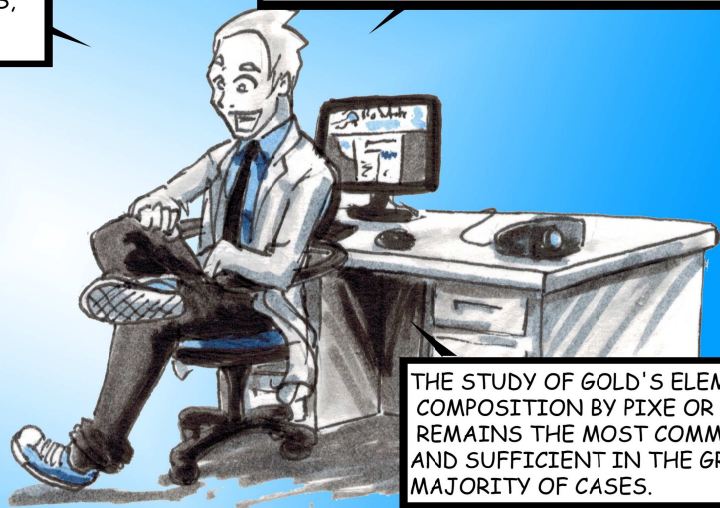
WHILE IN ABSENCE OF He (UNDETECTED), THE LAST MELTING IS MODERN...



THIS TECHNIQUES REQUIRE TO SAMPLE THE GOLD AND REALLY SPECIFIC ANALYTICAL CONDITIONS, WHICH MAKE IT REALLY EXPENSIVE...



IN ADDITION TO THE DIFFICULTY TO INTERPRET RESULTS, THESE LIMITATIONS EXPLAIN WHY THIS APPROACH IS RESERVED TO EXCEPTIONAL OBJECTS!



THE STUDY OF GOLD'S ELEMENTAL COMPOSITION BY PIXE OR ICP-MS REMAINS THE MOST COMMON AND SUFFICIENT IN THE GREAT MAJORITY OF CASES.