

# Authentication of fine wines by non-destructive scientific methods

## The content : radioactivity of the wine

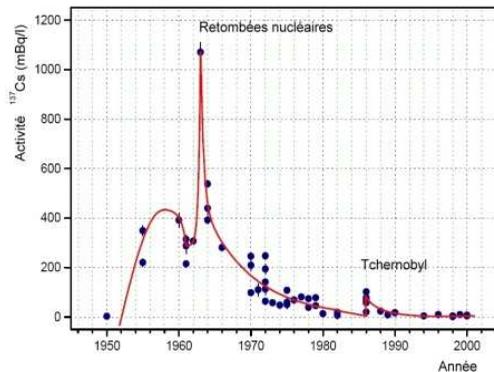
### Principle

The artificial radioactivity was created on the earth by the first atmospheric nuclear tests in the beginning of the 50's. Radioactive species like cesium 137 ( $Cs^{137}$ ) are diluted in the upper atmosphere, and then fall on plants and animals on the soil surface. After deposit on grapes, radioactivity is locked in the wine bottle during the winemaking process.

The content of  $Cs^{137}$  in the wine has changed over time, therefore it's possible to estimate the date of the harvest from a reference curve established in our laboratory.

### The analysis

The bottle is placed in front of a highly sensitive detector to count gamma-rays emitted by radioactive nucleides, and especially  $Cs^{137}$ . This radiation passes through the glass of the bottle and give the information of the content of radioactivity in the bottle to expertise.



### The result

- If we detect  $Cs^{137}$  in a bottle older than 1952, its absolutely a fake
- For bottles of 1952 until 80's, the method allows to check the age of the the wine with the supposed vintage
- For more recent vintages, the composition of the glass is necessary to specify the date of manufacture of the bottle.

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## **The container : glass composition**

### *Principle*

The industrial manufacturing process of glass from sand has changed over the centuries. These changes give changes in the chemical composition of glass of wine bottles. Today, these changes concern impurities in the glass due to the use of recycled bottles in glass factories. As these changes are continuous and uncontrolled, we can say that each bottle has his own chemical fingerprint which allows to identify it.

### *The analysis*

We use a high energy ion beam delivered by a particle accelerator to create X-rays emitted by atoms of the glass. These X-rays are analyzed and give the chemical composition of the glass. Previous studies of many certified bottles allow to build a data-base containing today around 500 references.



### *The result*

- With our database it's possible to date the glass with an accuracy of about +/-10 years.
- If there is a certified genuine bottle, it's possible to date with an accuracy of +/- 1 year.
- In all cases, the authentication concerns the glass of the bottle, and the expertise of the radioactivity of the wine is often complementary.