Department of Mines and Mineral Resources

1502 West Washington
Phoenix, Arizona 85007
(602) 255-3791 Toll Free in Arizona - 1-800-446-4259

ASSAYERS AND ASSAY OFFICES IN ARIZONA

Circular No. 58, February, 1995

by H. Mason Coggin, Director

The Arizona Department of Mines and Mineral Resources is often asked how or where to obtain an analysis of samples. The listed companies have informed this department that they do custom assaying for the general public. All assays are performed by or under the supervision of an assayer registered by the State of Arizona Board of Technical Registration, as required by law. For information on the registration status of specific assayers contact the Arizona Board of Technical Registration, 1951 W. Camelback Road, Phoenix, Arizona 85015, phone 602-255-4053 For additional information on mining, prospecting and mineral resources in Arizona contact the Arizona Department of Mines and Mineral Resources.

ARIZONA ASSAY OFFICES

AA = Atomic Absorption Analysis
ICP = Inductively Coupled Plasma Emission Spectrometry

DOUGLAS

Rochin Assay Office Inc.
Carlos Rochin, Registered Assayer
Rt. 1, Box 214-H
Douglas, Arizona 85607
Telephone: 520-364-8092
Speciality: Fire assay

DUNCAN

Robert Shantz
Robert Shantz, Registered Assayer
P. O. Box 650
Duncan, Arizona 85534
Telephone: 520-359-2654
Fax: 520-295-2654
Specialty: Fire assay, AA, ore dressing, laboratory testing

HUMBOLDT

Iron King Laboratory
Walt Statler, Registered Assayer
Iron King Road
P O Box 66
Humboldt, Arizona 86329
Telephone: 520-632-7410 or
1-800-325-4856
Speciality: Fire assay, geochemical analysis, wet chemistry

PHOENIX

OCM Inc.
John Sickafoose, Registered Assayer
9236 N. 10th Avenue
Phoenix, Arizona 85021
Telephone: 602-943-3573
Specialty: Fire assay, AA, wet chemistry, hydrometallurgical process development

MESA

CRM Industries
Craig McGhan, Registered Assayer
462 S. Gilbert Road, #788
Mesa, Arizona 85204
Telephone: 602-833-3821
Specialty: Fire assay, AA, wet chemistry, amalgamation, placer gold

TUCSON

American Assay Laboratories Inc.
George Burke, Registered Assayer
2775 E. Ganley
Tucson, Arizona 85706
Telephone: 520-294-8078
Specialty: Fire assay

Chemex Labs Inc.
Lloyd Twaites, Registered Assayer
2015 North Forbes Blvd. #101
Tucson, Arizona 85745
Telephone: 520-798-3818
Specialty: Fire assay, AA, minerals, coal, and environmental materials

Copper State Analytical Labs Inc.
D. A. Shah, Registered Assayer
710 East Evans Boulevard
Tucson, Arizona 85713
Telephone: 520-884-5811
Mailing Address: P O Box 7517
Tucson, Arizona 85725
Specialty: Environmental lab testing for organic and inorganic contaminants in soil, potable water, industrial effluent and air

Jacobs Assay Office
Ben Jacobs, Registered Assayer
Mike Jacobs, Registered Assayer
1435 South 10th Avenue
Tucson, Arizona 85713
Telephone:520-622-0813
Specialty: Fire assay, precious metal analysis, geochemical analysis base metals, ICP packages, preliminary metallurgical testing

Mountain States Research & Development Inc.
Marvin Schloatman, Registered Assayer
Walter Leming, Registered Assayer
P O Box 310
Vail, Arizona 85641
Telephone: 520-624-7990
Specialty: Fire assay, AA, ICP, metallurgical test work, gold, silver, and platinum, approximately 40 elements, umpire analysis

Skyline Labs Inc.
William L. Lehmbeck, Registered Assayer
James A. Martin, Registered Assayer
Charles Thompson, Registered Assayer
1775 W. Saguaro Dr.
P O Box 50106
Tucson, Arizona 85703
Telephone: 602-622-4836
Specialty: Fire assay, geochemical analysis

YUMA

Western America Mineral & Chemical Consultants
Robert E. Ingram, Registered Assayer
1169 Hacienda Drive
Yuma, Arizona 85365
Telephone: 520-726-0510
Specialty: Fire assay, analytical chemistry, optical emission spectroscopy, x-ray emission spectroscopy, metallurgical test work

THE ASSAYING PROCESS

The Department highly recommends analysis of samples by the fire assay method to determine precious metal content. Fire assaying, in use for thousands of years, still stands the test of time. The following summary of the process is taken from "Assaying," by Jim Steinberg in Mining Artifact Collector. The article was written from a historic standpoint, but the process is the same as the fire assaying of today except for the use of electronic balances, mechanical pulverizers, and so forth.

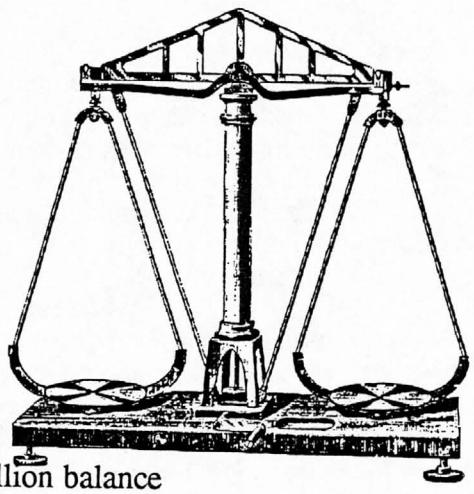
In Webster's dictionary assay is defined as follows: in metallurgy, the determination of the quantity of any particular metal in an ore or alloy; especially, the determination of the quantity of gold or silver in coin or bullion.

While the most common definitions of the word assay do revolve around the determination of gold or silver in ore or alloys, assay is itself a much broader subject which involves the quantitative analysis of chemical substances both organic and inorganic. The primary interest of this article is the assay of metalliferous ores. Because even this is a broad subject which has filled a large number of books, the highlights of fire assay by the scorification process in gold bearing samples are going to be summarized here.

Initially, the sample must be reduced to a powder so that it can be tested. This powder is often called "pulp" and the scales to weigh it are called "pulp scales." The assayer begins by running the sample through a crusher. With many crushers, the fineness of the output is adjustable. The sample is still not sufficiently fine after initial crushing, so the assayer then puts it onto a "buck board" for further pulverization under a muller that rubs the material into a finer state with a sliding motion. Harder samples are made finer using a device called a "rocker" that uses a heavier weight upon the sample being pulverized. Assayers doing a smaller volume of work might use an iron mortar and pestle, although it requires considerably more effort.

As the pulverization of the ore sample proceeds, the assayer mixes and then divides the sample into smaller and smaller portions until he has reduced the amount of the sample to the size that he will actually process. This can be done manually or by using devices designed to assist in the sampling process. This is done to assure a uniformity within the sample and to increase the accuracy of the assay to be performed.

When the sample has been sufficiently pulverized it must be run through sieves of the appropriate size. Material that does not pass through must be further ground until the entire sample will pass through the sieve. What has passed through the sieves must then be carefully mixed and then stored in a marked container. The contents of these containers should not be shaken or agitated as this can cause the materials to begin stratifying according to their masses and upset the accuracy of the process.



Bullion balance

From various parts of the container, selected portions of the sample are taken and weighed. The weighed sample is then placed in a scorifier, a dish that can sustain the heat of the assayers oven. Along with the sample litharge (a form of lead), various chemicals that will assist in allowing the metals in the sample to separate from the slag are included.

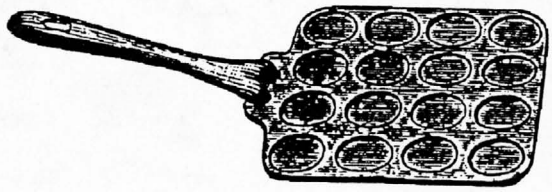
This mixture is roasted in the assayer's oven until the melted slag completely covers the lead bead that forms in the scorifier.

The sample in the scorifier is next poured into the cup of the scorification mold. Here it is allowed to remain until it is cold. Once cold, the sample is removed from the mold. It is cone-shaped, with the metal at the apex of the cone and the slag forming the bottom. The metal part, or lead button, is detached from the slag. This button may then be hammered into a cube with no sharp corners.

The button is placed into a cupel of appropriate size that is then placed in the furnace. Cupels are comprised of a material called bone ash. When it has come up to heat, the button is placed in the cupel. In this process lead and other impurities within the button are both oxidized and driven into the material of the cupel itself. A good cupel is capable of absorbing its own weight in litharge (the lead in the sample). The metal in the cupel melts and will be observed to become smaller as the process proceeds.

Towards the end of the process, the surface tension of the metal will draw it into the shape of a bead. The bead will appear to be in rapid motion and at the moment the process is complete, an optical energy release will sometimes be visible as a "flash" or "blick." At this point, the cupelation is complete and the cupel with its bead may be removed from the oven.

Now the bead is removed from the cupel. The composition of the bead should now be gold and silver. The bead is weighed in a type of scale made specifically for this task called a button scale. Button scales, because they are measuring

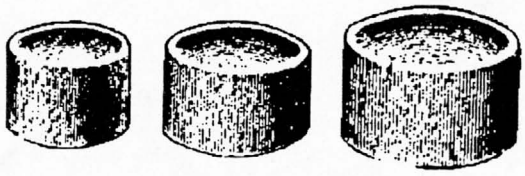


Cupel tray

something so small, must also be very accurate and are thus always enclosed, while analytical or pulp scales do not always require enclosure. Weighing the bead has shown how much metal is there, but has not told how much is gold and how much is silver.

The next step of assaying is called "parting." In this step the gold and silver are separated from each other by solution. The weighed bead is flattened, placed in a porcelain capsule and treated with a solution of water and nitric acid. Once reaction begins, the capsule is warmed. Silver in the bead forms a solution of silver nitrate that is carefully washed away until only the gold, if any, remains. This is gently dried in the porcelain capsule and then removed.

The final sample of gold is again weighed in the button balance, unless it is too small to be weighed, in which case it is simply described as a "trace" or "color." From the weight of this bead the assayer will then calculate the gold and silver ore value per ton of ore. The assayer may use a special set of assay ton weights when weighing the gold to more easily calculate the assay value of the ore.



Cupels