Plaster of Paris – Gypsum:

Plaster of Paris is de-hydrated gypsum. Gypsum is a naturally forming non-metallic mineral, found as a rock or sand composed of 70.1% calcium sulphate and 20.9% water by weight. Its chemical formula is $CaSO_4 \cdot 2H_2O$.

Gypsum is found naturally in most parts of the world with plentiful supplies in Canada and the United States. Large gypsum deposits were formed during the Silurian period of the Paleozoic Era of the Geological calendar. This corresponds to about 300 million years ago. At that time salt water oceans covered most of North America. As they receded, swamps and "dead" seas were formed. In the arid climate the concentration of the salts in these seas increased. Gypsum was one of the first minerals to crystallize because of this over-concentration. As millions of years passed, decayed vegetation and depositions of other minerals produced these layers of gypsum and limestone. They were finally covered with glacial deposits from the retreat of the glaciers which covered this region about 25 thousand years ago. In absolutely pure form, gypsum rock is white. However it normally contains impurities, whose presence make the rock appear gray, brown, pink, or almost black.

White Sands New Mexico is the largest open natural gypsum field in the world. The natural deposits usually lie in flat beds approximately 48 inches thick, interlayered with limestone. As with all natural minerals, rocks, dirts, clays and ores, trace metallic elements will naturally occurring and cannot be separated with known technologies. The mineral, gypsum would be best classified as a **"Perpetual Resource"**, meaning that there are well over 350 years or more of gypsum natural known resources worldwide. There are enormous occurrences of gypsum that have been identified in every continent except Antarctica. According to the U. S. Geological Survey and the 2009 Roskill report for gypsum and anhydrite there are billions to trillions of metric tons that have been identified throughout the world. For example, Brazil's government has identified about 1.3 billion metric tons of gypsum resources. There are at least 700 million short tons of gypsum resources identified in the U. S. The CIS has "reserves" of about 4.3 billion metric tons. India has about 1.2 billion metric tons of "reserves". China's "reserves" are reported to be about 1.6 billion metric tons and Iran's are estimated to be 2.2 billion metric tons. Currently USG maintains around 10 natural gypsum operations across North America for extraction of materials for drywall and plaster products. In addition, we have a few operations currently idled and one recently closed and reclamation.

In addition to mined gypsum there is 'Byproduct' gypsum. This product has several names but it basically is chemically produced gypsum (not mined) or a byproduct, created during manufacturing, industrial, or chemical processes. This byproduct gypsum is identical, chemically ($CaSO_4 \cdot 2H_2O$) to natural (mined) gypsum. This byproduct gypsum is usually referred to by its production processes. Some of the various types of byproduct gypsum are flue-gas desulfurization (FGD) gypsum, fluorogypsum, citrogypsum, phosphogypsum, and titanogypsum.

The standard process of limestone scrubbing of the stacks on coal-fired power plants produces calcium sulfite, a chemical having little or no use and therefore is discarded. Many western power plants will use it as fill for open pit rehab requirements. This desulfurization can be modified to produce calcium sulfate, with added cost to the power company. This material can be used by gypsum drywall companies and cement companies. The use of this material is common in the eastern half of the US due to the high sulfur content of coal used by this area's power plants and therefore an equally larger amount of usable industrial process secondary material.

Currently, during this down construction market, this recaptured gypsum provides about 50 to 60% of the drywall market raw material needs.

Flue-gas desulfurization (FGD) gypsum is the most suitable for the production of drywall. According to the U.S. Geological Survey the U.S. currently use about four and a half million tons of this type of Byproduct (or Recaptured) gypsum annually. Most of this is used in the manufacture of wallboard. FGD gypsum is recovered as a byproduct of removing polluting gases from the stacks of fossil burning power plants to reduce the emission of harmful materials into the atmosphere. For the latest information on the EPA's findings on the use of FGD gypsum, click HERE.

The worldwide consumption of gypsum in 2010 is estimated by the U.S. Geological Survey to have been about 146 million metric tons. Gypsum is processed from 88 countries. The main use of gypsum is in the construction industry. But there are many other uses including soil amendments, molding, art, porcelain, pharmaceutical fillers, calcium fortification in foods, filters in beer production to name a few.

Gypsum is also called Hydrous Calcium Sulphate because one molecule of calcium sulphate is combined with two molecules of water. Its chemical formula is $CaSO_4 \cdot 2H_2O$. By volume this works out to nearly 50% water. This water is called "Water of Crystallization." It is held in the gypsum molecule and is only driven off at temperatures above 212° F, just as steam is driven off from boiling the contained water. This is why gypsum drywall is so good in fire.

Plaster of Paris, as stated above, is the result of cooking gypsum and driving most of the water from the mineral ($CaSO_4 \cdot 2H_2O$) forming a thirsty powder. It is a solid to solid phase change; requiring heat (212° F) to turn gypsum to Plaster of Paris and steam, then when water is added to Plaster of Paris it turns to gypsum giving off heat. This reaction can be repeated endlessly, requiring or exhausting the exact same amount of energy per phase change!