A FIELD TRIP TO TICK AND RED ROCK CANYONS

By JOHN W. LUCE

The March field trip of the Los Angeles Mineralogical Society was a journey up Mint Canyon and over to the old Sterling Borax Mine in Tick Canyon, then to Vasquez Rocks and on to Red Rock Canyon in the Mojave Desert.

The group met in Saugus at eight o'clock Sunday morning, March the twenty-first, with Professor Alfred Livingston, Jr., acting as guide, and giving the geological history of the main features along the route.

At the Sterling Borax Mine some splendid samples of colemanite and howlite were obtained. Some small samples of ulexite (cotton balls) were also found.

The geological story of the Tick Canyon and Vasquez Rocks area was told by Mr. Livingston.

In the dark brown basalt of Red Rock Canyon were found the contrasting white nodules of analcite and natrolite, which when broken open revealed the beautiful crystals of these minerals lining the little geodes. Some of the lucky members found fragments of fossil bone that had been weathered out of the sediments of the canyon which lie above the basalt beds.

MINT CANYON AND SAUGUS SERIES

On leaving Saugus the Mint Canyon road follows the Santa Clara River to the mouth of Mint Canyon. It traverses sediments of the Saugus formation. These are poorly sorted terrestrial deposits of conglomerate sandstone and a mixture of the two with red clay beds dispersed through them at intervals. These sediments are yellow to light gray and are classed as being from late Pliocene to early Pleistocene in age.

At the mouth of Mint Canyon the Mint Canyon series is encountered. These terrestrial sediments are Miocene in age, and in many ways similar to the superimposed Saugus beds. They consist principally of poorly sorted sandstone and conglomerate, are usually light in color and contain many mammal fossils.

About twelve miles from Saugus, Mint Canyon changes from a wide, flat-bottomed valley to a steep gorge, where the loose sediments of the Mint Canyon Series give way to the harder metamorphic rocks of Sierra Pelona. It is just before reaching this contact that the gravel road to Tick Canyon meets the highway. Here the course lies east over the divide between the two canyons, and down into Tick Canyon to the old abandoned workings of the Sterling Borax Co.

GEOLOGY OF TICK CANYON-VASQUEZ ROCKS REGION

The formation in which the borax deposits were formed is part of the same sediments that produced the picturesque and well known Vasquez Rocks. These were also visited on this trip.

The sediments in this area were laid down in what were, according to W. S. W. Kew, probably Oligocene and lower Miocene times. They were deposited in a basin that might be called the ancient Sierra Pelona Valley.

This ancient valley was bounded on the north by the high mass of the Sierra Pelona Range and on the south by the San Gabriel Mountains, which were also highly elevated at that time.

From these two mountain masses

great depths of continental conglomerates, sandstones, and shales were deposited in the basin. These beds are over 8000 feet thick and have been classified as Sespe. The upper 4300 feet of these beds are of a fanglomerate character.

The site of the borax deposit was probably at a low point in the basin with evidence that a fresh water marsh existed at the site, as many plant fossils have been found there. Conditions in this marsh were favorable for the concentration and deposition of material, probably marl or other calcareous material from which the borate deposits were later formed.

The ancient Sierra Pelona Valley after receiving for ages the sediments from erosion of the adjacent mountain masses, which by this time were eroded to a low relief, were disturbed by orogenic forces which again raised to a great height the Sierra Pelona and San Gabriel Mountain ranges.

The uplift of these mountain blocks on either side of the valley carried with them, to an extent, the adjacent sides of the valley floor enough to deform the valley sediments in such a manner that a large syncline was formed parallel to the ranges.

This deformation of the sediments and uplift of the mountains blocks took place at the beginning of the Miocene times. The accellerated rate of erosion and deposition from these newly elevated masses produced great beds of fanglomerates, the poorly sorted conglomerates and sandstones of the Mint Canyon Series. These beds lie unconformally on the Sespe.

It is the older steeply tilted beds of the colorful Sespe Series which, through differential weathering, result in the sharply serrated forms of Vasquez Rocks. It is also the folding of these beds that caused the borax deposits, which were normally horizontal, to be now in a nearly vertical attitude.

TICK CANYON BORAX DEPOSIT

This deposit, owned by the Sterling Borax Company of Los Angeles, in 1918 was second only in importance to the Death Valley deposits. The deposit in Tick Canyon had thicker and more regular beds than the Death Valley deposits as then known, the total thickness of the Tick Canyon beds being eighty-five feet. The largest vein, which was practically pure colemanite with howlite nodules, was from six to ten feet thick with many thinner veins alternating with black carbonaceous shale.

The bedded character of the colemanite is evidence that the deposits were formed by crystallization from an evaporating solution in a closed basin or lake in this arid climate. Much of the clay bedded with the borates is believed to have been precipitated from the materials forming the borates.

The lack of any considerable amount of carbonates and sulphates of lime and soda, as are general in such deposits as Searles Lake and Death Valley, indicates that a different condition here existed, a condition, the results of which cannot be explained by the simple evaporation of meteoric waters, carrying dissolved salts. Furthermore the evidence of considerable marsh vegetation indicates a fresh water rather than a saline lake for a considerable period of time.

Waters entering this Oligocene basin could not have carried any large quantities of alkali salts, or if carried, conditions could not have been favorable for their concentration to a point of crystalization.

The theory of this deposit which has been accepted as most plausible is that beds of marl or calcareous tufa were deposited in this marsh. It is then believed that waters charged with boracic acid, probably of volcanic origin, flowed into the basin, possibly from springs in the surrounding volcanic masses.

This boric acid on reaching the calcareous material reacted to form lime borates, liberating carbon dioxide and clay impurities. It is believed that much of the clay, which now forms the shale beds, was precipitated in this manner.

The carbonaceous material which discolors the minerals and blackens the shales is believed to have been derived from the released carbon dioxide, being occluded in the clay mud and later reduced to carbon.

On the other hand some of the shales in the area are quite bituminous which indicates that the carbon in the deposit is from organic matter. Probably both sources contributed.

These beds of the deposit are now dipping about 80 degrees south and striking east and west, and are overlain by heavy bedded sandstone which was deposited on the lime borate beds and shales following their formation.

BORATE MINERALS IN THE STIRLING MINE

The principal mineral of this deposit is the calcium borate, colemanite — $Ca_2 B_4O_8 .2B(OH)_3 2H_2O$.

Arthur S. Eakle has the following to say about the mineral which is taken from Bulletin No. 9, Volume No. 6, of the University of California Geological Publications.

"The Neocolemanite (colemanite) is massive crystalline with a very glassy luster and eminent clinopinacoidal cleavage. It has also distinct basal cleavage, yet does not part readily in this direction. This basal cleavage can be seen as lines on the clinopinacoid, and is a very important help in the proper orientation of the crystals, because the angles for the positive faces are quite similar to those for the negative. The clinopinacoidal cleavage is so prominent that practically all of the mineral comes from the mine (Stirling Mine) in cleaved fragments and cleaved masses. Specimens with a divergent columnar structure, the columns curving into fanlike shapes, are frequently found. A peculiar fibrous form of the lime borate with a satin luster occurs in the main shaft, which strongly resembles satinspar. Crystals are rare and only a few good specimens were found." . . . "The Neocolemanite has eighteen forms and seven of them have no correspondence on colemanite." Further information on the crystal habits and optical properties may be found in this bulletin.

Another mineral that occurs in considerable quantities is the lime silica borate known as Howlite—$C_2B_4O_8$. $B(OH)_3$. $2SiO_3$. This mineral occurs in nodules ranging in size from very small to pieces a foot or more across. It occurs in irregularly shaped knotty lumps with surface roughness resembling a head of cauliflower.

The howlite lumps occur in the veins of colemanite, the crystals of which are found grown around the howlite lumps. The two minerals were formed simultaneously from the same evaporating solutions, the howlite masses probably representing a mineral segregation of the silica borate. Formation of the howlite was due either to the presence of some silica in the entering solutions, in the form of a metasilicic acid, or was derived from a siliceous marl or travertine of the original lime deposits. This silica enters into the crystallization, of what would otherwise have been colemanite, by replacing water of crystallization and boric acid. The howlite thus formed was probably rapidly precipitated as indicated by the very fine crystalline form, no crystals of megascopic size having been found. The formulae as written below shows the chemical relationship of these two minerals:

Colemanite .... $Ca_2 B_4 O_8$. $2B(OH)_3$. $2H_2O$.
Howlite .... $Ca_2 B_4 O_8$. $B(OH)_3$. $H_3 SiO_3$.

The above formula shows how the silicic acid entered into the howlite formula by replacing water of crystalization in the regular lime borate.

Howlite nodules from the Stirling Borax Co. property are generally black from carbonaceous matter in the deposit. This carbonceous material is scattered throughout many of the nodules in irregular lines. When a specimen like this is cut and polished it resembles a beautiful piece of marble, and could be so used for small articles.

Ulexite—the other mineral found at the Stirling Mine in Tick Canyon—is a borate of calcium and sodium and is commonly called "cotton balls." This boronatrocalcite has the formula—2Ca. Na_2O. $5B_2O_3$. 16 H_2O and occurs in light masses of fine silky fibrous crystals, of a pure white satin-like luster.

(To Be Continued in Next Issue)