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Evolution of the Allard Stock, La Plata Mountains, Colorado
DOME- NO COMPRESSION

LA PLATA, COLO.


Ku Dakota ss
Up. Ju ss shale. Morrison. La Plata 1s at base, tpb 8' Replaced by py. CM.

Entrada ss massive, 200'. Imp. veins here

Dolores: Mudstones, fg. ss Wide strong veins in Entrada ss above pinch below in Dolores.

J-Tr Cutler Red

Arkosic ss, cgl., limy sh, mudstones,

Permian Rio. Sh., ss, thin sandy ls.

Penn. Hermosa Ss, sh, ls. Basal formation in district.

Structure: 15 mi. dome, blending into SW flank of far broader San Juan uplift. Beyond L.P. dome beds flat. Stocks cut across seds without disturbing their structure, hence had little direct influence on shape of dome. But thick extensive sills must have played large part in the doming.

Man veins in central part of district follow minor flts. which radiate in general from center of "La Plata uplift "and probably developed in response to tensional stresses set up during the formation of the dome." p. 530.

On outskirts of this sharp dome are a series of large faults nearly barren of ODs and which offer slight suggestion of concentric arrangement about the uplift. Another series of short discontinuous minor flts radiate from center of dome and contain ODs in many places. Ore skips big shear faults, favors tension fissures.

Gold-silver tellurides. Arg tetrah., ruby silvers, py, ccpy, PbS ZnS.

Gangu., quartz, clared /

Neglected mine, one of main producers, E-W radial fault, E of apex. In fresh red shales, arkosic ss of Cutler, dip E, SE, to 100. These cut by S-dipping, E plunging @ 200° porphyry mass 50' thick, 250' high. Feeder for sills Strong flt zone parallels ph. chimney; s. twithin the dike. S. t. along HW or FW, N or FW side has moved up and to E steeply. First period of fracturing, solutions rising along same channel as did porphyry silicified the incompe. WRs; these later sheared, brecciated, breccia cemented by quartz. Main shoot along chimney, pitches same.

Qtz s.t. drusy. Steaks and irregular masses of tell. Tell. line vugs in quartz.

Tension along radiating fractures: uplift only. Wide fissures in brittle rock, mushy shale above and below. Soft rock thinned under doming by plastic flow. Brittle rock had to break.
Fig. 2

Delete border

$2\frac{1}{2}$

$S$ border

SPRING LINE
Eckel, 1936: The general structural picture of the La Plata Mountains is that of a relatively sharp dome in the sedimentary and igneous rocks. On the outskirts of the dome there is a series of faults of large displacement, which are nearly or quite barren of ore deposits and which offer a slight suggestion of concentric arrangement about the uplift. Another series of short, discontinuous faults of small displacement radiate from the center of the dome and contain ore deposits in many places. P.531.

Eckel, 1949: From the outskirts of the dome, the rocks rise gradually toward the center, with dips of 5 to 20, until they reach the steep hinge fold that is the most striking feature of the structure. The zone involved in this hinge fold is irregular in plan but has the general shape of a horseshoe, with the open end toward the south.

Along this hinge zone the beds generally dip outward at angles of 25 to 60. Both inside and outside of the hinge the beds flatten abruptly. In places the rocks are sheared and brecciated along the fold, as shown on the geologic map, many of the ore-bearing fractures are concentrated within or near it. (The hinge) shows clearly in some cross sections, as A-A' and C-C', but it does not show in some others, such as B-B'. This difference in expression is partly due to the fact that the steepness of the fold varies from place to place, and partly to inaccuracies in the topographic base map, which preclude accurate plotting of the geologic features. P.43.

Nearly half of the 6000' uplift of the base of the Dolores is accounted for by sills that are actually exposed. Presumably the Hermosa and lower sedimentary beds have not yet been exposed by erosion also contain intercalated sills. The proportion of sills to sedimentary rocks is constant throughout the stratigraphic section, the aggregate thickness of porphyry is ample to account for the entire uplift. If, on the other hand, less porphyry is associated with the Hermosa beds than with the Cutler and younger ones, it is necessary to suppose that before or during the porphyry intrusions the basement rocks were pushed upward by some localized force. The latter supposition gains some weight from the fact that an upthrust of this sort might readily produce the steep hinge fold, whereas it is more difficult to understand how the simple intrusion of porphyry bodies could achieve such an effect.

In places the rocks yielded to the uplifting forces by faulting rather than by folding. This faulting resulted in the strong barren faults in the northwestern and southern parts of the district. Many minor faults, were formed at about the same time as a result of the tensional stresses set up by the doming. These faults, some of which were later filled with ore in places, are most numerous along the horseshoe-shaped hinge fold, where the stresses were greatest.
In the La Platas

Rensselaer H. Toll
1958a University Ave.
Berkeley, Calif.
Mining Flourishes in Norway

The year 1939 was good, but the future is obscure because of war conditions on the Continent

K. L. Böckman

Tidsskrift for Kjemi og Bergvesen
Røros, Norway
LA PLATA COMPARED TO RICO.

Both domes; both on SW flank of San Juan uplift. But while Rico dome shows pre-9 in eroded core, La Plata dome shows as deepest formation exposed, top 500' of Hermosa. Formations as high as Morrison are extensively exposed only 2 mi. plus from apex.

Structure: Both strictly autochthonous; outside of domes beds flat or nearly gently regional dip SW away from San Juan major uplift. Each about same size: 12-15 mi. diameter.

Intensity of doming also seems about the same: dips of 5-20 common; La Plata shows local dips up to 60°. But while at Rico sills caused relatively small % of doming, Eckel ascribes a large part of the La Plata doming to the many thick porphyry sills there.

In strong contrast to Rico, faults are comparatively rare at La Plata. but there are local small folds imposed on the dome, not all of which are caused by intrusion of sills. Many La Plata veins in central part of district along minor faults which in "radiate in general from the center of the La Plata uplift and probably developed in response to tensional stresses set up during the formation of the dome." p.530.

However, as at Rico, at La Plata there is a series of major faults, nearly or quite barren of ore, which offer a slight suggestion of concentric arrangement about the uplift (upthrown sides toward apex of dome). In contrast to these barren synthetic faults is the "series of short, discontinuous faults of small displacement" which "radiate from the center of the dome and contain ore deposits in many places." p.531.

At Newman Hill, Rico, both concentric and radial faults carry ore or are associated with (blanket) ore. Elsewhere chief ore-bearers, outside of other blankets, are radial minor faults. La Plata dome may be more symmetrical than Rico.

Sediments as Loci for Ore Deposits:

Rico: Great bulk of ore in Hermosa.
La Plata, Colo. This is one of the laccolithic masses near the San Juan uplift, along the SW spoke of the wheel.

Oldest rock Penn., ss., sh., is. Permian sh., ss., cgl. /Juratris ark., ss, cgl.

Soft, yielding except where baked

sh (limy) mudstone/Ju up. ss., sh. Ku Dakota ss.

Dolores at base of Upper Jurassic shale-prevented open fissures. Wide strong veins in Entrada ss above pinch out going down into Dolores. Imp. veins in Entrada. Is in Morrison replaced by ore. At bottom.

Intrusions near apex of dome irregular, dio-to M-P. Many sills, some laccolithic (soft rocks). Sills decrease away from center. Early intrusions (sills) as usual. No CM. Sills brittle, fracture well, open fissures. Porphyry dikes accompanied by silicif. haloes, hence fissures intersecting dikes or running along them are likely to be mineralized because they are in brittle rock. Dikes being brittle tabular masses in soft rock (where unbaked) veins are apt to follow them anyway. Same thing at Pachuca, both with regard to dikes in soft H T altered andesite, and tabular masses of silica which ascend tight fractures in soft rock and silicified the walls; vein, ore in such masses, pinched out where fracture left brittle silica and entered soft mushy H T altered rock.

Next monzonite, stock or stocks. Mt. Moss stock. Then diorite CM. Lewis Mt. stock. Now the M and dio stocks cut thru seds without locally disturbing them, which is good argument that the domal uplift took place after intrusion of these stocks, whole mess uplifted together. Intrusives swell in shale, narrow in silic., beds like Entrada ss. As usual, last stage basic dikes.

Dome blends somewhat into SW flank of San Juan uplift (cf. Cerillos-Sandia). Beds dip away in all directions from the 15 mi. dome; outside all flat. While the major stocks app. did no doming, intrusion of large amount as sills around center, thinning outward, caused a large part of doming

Important faults are few (the more perfect the doming, the fewer the flts)
Many veins in central part follow faults radiating in general from the center of the dome and "probably developed in response to tensional stresses set up during the formation of the dome" (p. 530).

Produced over $4,000,000 Au., over $1,000,000 Ag. Gold-silver tellurides, free gold. Argentif. tetrahedrite, stephanite etc. py, copy, ZnS, PbS stibnite. Gangue qtz., chalced. Main ore bearers Entrada and Morrison, brittle. These circle the dome far from center. Neglected vein in long a porphyry dike radial to dome (E-W, E of dome) Repeated openings.

Presence of wide fissures in brittle rock with mushy shale above and below good evidence of fissuring thru uplift. How else? Stretching, soft rock thinned by plastic flow; brittle couldn't, had to break.

I'm not quite half thru the alphabet nor thru the list of domes ore districts either; but I had better turn to the more elongated domes grading to anticlinal forms. Time forbids more than a few brief mentions.
PLATE 2

STRUCTURAL MAP OF
LA PLATA DISTRICT