Main morpho-structural elements in Bolivia from west to east are the following.

1. The Cordillera Occidental which exposes Tertiary and younger extrusives.
2. The Altiplano depression with thick Tertiary and Quaternary sediments and extrusives in a probable downthrown block.
3. The Cordillera Real, "backbone of the Bolivian Andes," with Tertiary or Mesozoic granitic and quartz monzonite intrusives forming peaks exceeding 21,000 feet and containing the rich tin-mining districts of Bolivia. A southern continuation of this element (without granite) is called the Cordillera Central.
4. The Cordillera Oriental consisting mainly of Ordovician and Devonian sediments. Carboniferous, Cretaceous, and Tertiary sediments are preserved in synclinal cores.
5. The Subandean zone or Andean foothills generally consisting of marine Devonian and continental post-Devonian sediments. The producing oil fields of southern Bolivia are located within this zone.
6. The open country called the Beni plain and Chaco plain in the north and south of Bolivia, respectively, present site of oil exploration activity.
7. The Brazilian shield exposing Precambrian basement.

The Paleozoic section in Bolivia includes rocks from all periods and has a maximum thickness on the order of 40,000 feet. Cambrian, Ordovician, Silurian, and Devonian dominantly shallow marine shales and sands were deposited throughout the Andean and Pampa areas and along the Brazilian shield. At the top of the Ordovician is an unconformity with apparent southward truncation of upper, middle, and lower Ordovician beds. A thin but widespread layer of glacial origin occurs at the base of the Silurian. Sediments of Lower, Middle, and Upper Devonian age conformably overlie the Silurian.

The Permo-Carboniferous sediments consisting of alternating glacial and interglacial deposits of continental origin in southern Bolivia. These become increasingly more marine toward the northwest. Lower Permian limestones known in Peru extend into Bolivia as far as the Subandean zone.

Post-Permian continental type deposition follows; however, age distribution is difficult to establish. A large gap in sedimentation probably exists between Permo-Triassic and Upper Cretaceous. Age of the Vitiacua limestone is questionable.

Thick continental Tertiary deposits fill parts of the Subandean zone and the Chaco and Beni plains, and are known in the synclines in the southern part of the Eastern Cordilleras. A Tertiary sequence of a different type has been found beneath the Quaternary of the Altiplano.

Basalts of Cretaceous, late Tertiary, and Quaternary age are present. Permian basalts found in Peru are rare or absent in Bolivia.

The conspicuous elbow of the Andes in the Arica-Santa Cruz corner possibly had its origin in Precambrian time and has guided the tectonics ever since.

A transcurrent fault zone is believed to have influenced Bolivia tectonics between Corumba-Santa Cruz and probably continuing through the Cochabamba-Oruro areas to the Chilean coast near Arica.

The present Bolivian Andes are the product of a late Tertiary orogeny. By comparison, the earlier orogenies of the Mesozoic and Paleozoic exerted but a mild effect on the structure of Bolivia.

Although lateral compression is generally believed responsible for the folding and faulting of the Andes and of their eastern foothills, some geologists now strongly postulate mostly vertical uplift created the present picture of this impressive mountain system in Bolivia.

11. Role of Sub-Andean Fault System in Tectonics of Eastern Peru and Ecuador: C. K. HAM and L. J. HERRERA, JR., Wm. Ross Cabeen & Associates, Lima, Peru

The Sub-Andean fault system is believed to be the most extensive tectonic feature of the South American Andes. The following discussion is restricted to its role in the tectonics of Peru and Ecudaor. A summary of the regional tectonic features and their histories for Peru and Ecuador is presented in order to orient the reader.

The fault system lies along the eastern front of the Andean ranges demarking the Andean uplift on the west and the potential petroleum province of the Sub-Andean basin on the east. The arcuate trace of this system as well as the trends of the Andean ranges and the Sub-Andean basin parallel the configuration of the western margin of the Brazilian and Guayana Precambrian shields.

The Andean uplift contains Precambrian and Mesozoic plutonic intrusions, Paleozoic metamorphic rocks, Paleozoic, Mesozoic, and Tertiary sedimentary rocks, and Tertiary volcanics. Metamorphic and sedimentary formations are highly deformed by folding and faulting and are commonly mineralized.

The Sub-Andean basin contains a thick sedimentary sequence of Paleozoic, Mesozoic, and Tertiary rocks which overlie a basement of Precambrian igneous and metamorphic rocks similar to that of the shield regions. Foreland folds developed east of the fault system are generally faulted along the eastern flanks and correspond structurally with the compression of deformation characteristic of the Andean uplift. Degree of folding and faulting diminishes eastward toward the shield regions.

The Sub-Andean fault system is an imbricate zone of west-dipping reverse strike faults along which the western blocks are elevated with respect to the eastern blocks. Stratigraphic separations of as much as 15,000 feet have been observed along faults of this system. It is possible that other types of movement, especially lateral movement, have occurred along this system during its history. A set of younger cross faults has subsequently offset the Sub-Andean system.

It is believed that the Sub-Andean fault system has played an important role in the migration of petroleum in the Sub-Andean basin.

12. "Backbone" of Colombia[1]: CYRIL JACOBS, Consulting Geologist, Bogota, Colombia; HANS BURGL, Geology Professor, Universitad Nacional de Colombia; and DANIEL L. CONLEY, International Petroleum (Colombia) Limited

The "backbone" of Colombia is the northern part of the Andes Mountains. The mountain system is here divided into the Eastern, Central, and Western Cordilleras. The Central and Eastern Cordilleras are separated by the down-faulted basin of non-marine Cenozoic deposition through which the Magdalena River flows in its middle and upper reaches. The valleys of the upper Cauca and upper Patía rivers mark the approximate boundary between the Western and Central Cordilleras. The Santa Marta and Perijá Mountains and the Pacific Coast Range are related to the Andean system.

[1] Prepared under auspices of The Colombian Society of Petroleum Geologists and Geophysicists.