

Comments on the article “The IARC re-classification of talc carcinogenicity: a move in the wrong direction?” by A.A. Korchevskiy and A.G. Wylie (2025)

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Comments on the article “The IARC re-classification of talc carcinogenicity: a move in the wrong direction?” by A.A. Korchevskiy and A.G. Wylie (2025)

Dear Editor,

This letter comments on the paper “The IARC re-classification of talc carcinogenicity: a move in the wrong direction?” by Korchevskiy and Wylie, recently published in *Critical Reviews in Toxicology*.

In 2025, the International Agency for Research on Cancer (IARC) released Volume 136 of the Monographs on the Evaluation of Carcinogenic Risks to Humans, dedicated to talc (and acrylonitrile) (IARC 2025). The overall evaluation concluded that talc is probably carcinogenic to humans (group 2A), based on three combinations of evidence: (a) limited evidence for cancer in humans and sufficient evidence for cancer in experimental animals; (b) limited evidence for cancer in humans and strong mechanistic evidence in human primary cells and experimental systems; and (c) sufficient evidence for cancer in experimental animals and strong mechanistic evidence in human primary cells (IARC 2025). This new assessment revises the conclusions of the previous IARC evaluation of talc published in Volume 93 in 2010 (IARC 2010), upgrading talc from “Possibly carcinogenic to humans” (group 2B) to “Probably carcinogenic to humans” (group 2A).

Following the standard layout of the IARC Monographs, the first section of Volume 136 addresses the identification of the agent, as well as its production and use. In this context, a summary table (Table 1.1, p. 53) presents the characteristics of talc ores worldwide that are of past or present commercial interest. The table was intended to provide an overview of major talc occurrences globally, including a tentative classification of the geological origin of the talc; its type (cosmetic or industrial); the verified, probable, or possible presence of carcinogenic minerals (asbestos and respirable quartz) at each site or area; the estimated period of mining activity; references describing the geological setting; and references to cancer or mechanistic studies in humans conducted in mining settings associated with those areas.

In their paper, Korchevskiy and Wylie (2025) argue that the “reclassification was made not based on any new scientific information available” and that “there are significant mineralogical issues in characterization of talc, evidence for carcinogenicity of pure talc in experimental animals cannot be estimated higher than ‘limited’, in human study higher than ‘inadequate’, and that utilization of separated mechanistic criteria without contextual analysis and proven mode-of-action (MoA) can cause significant uncertainties in the determination of carcinogenicity in humans”. With specific reference to the mineralogical description of talc, Korchevskiy and Wylie (2025) claim that “the content of the table (Table 1.1) appears to be inconsistent with scientific understanding of talc mineralogy and the sources referenced by the monograph itself”, and that “with such poor

understanding of the occurrences of talc and associated minerals, it is difficult to see how exposures were evaluated, especially with respect to possible presence of elongate particles in talc samples”.

The author of this letter is a mineralogist who served as a member of the IARC Working Group on the Identification of Carcinogenic Hazards to Humans, which met in Lyon, France, from 11 to 18 June 2024 for the evaluation of talc.

This letter focuses on the issues related to the characterization of talc and addresses all observations made by Korchevskiy and Wylie (2025) concerning talc mineralogy. It provides detailed explanations intended to clarify and respond to the alleged inconsistencies and inaccuracies raised by those authors.

General comments

In this section, the author discusses all the general issues raised by Korchevskiy and Wylie (2025), which, according to them, bias the description of talc mineralogy. The author explains, point by point, the reasons to explain the alleged inconsistencies and inaccuracies.

First of all, on page 6, 4.1.2. *What is talc*, the definition of talc given by Korchevskiy and Wylie (2025) is incomplete. Talc is not just a mineral (natural material) but also a synthetic product. The IARC v.136 Working Group also considered the synthetic counterparts because it is foreseeable that these products, being asbestos-free, will be able to acquire more and more market share in the future.

On page 6, 4.1. *Mineralogy of talc*, Korchevskiy and Wylie (2025) state that “With such poor understanding of the occurrences of talc and associated minerals, it is difficult to see how exposures were evaluated, especially with respect to possible presence of elongate particles in talc samples”. It is undeniable that talc mineralogy is a complex matter and that talc samples are often composed of a mix of minerals with various particle shape, including elongated, fibrous, and asbestiform. The evaluation of the occurrence of asbestos minerals for the various active and abandoned talc mining areas was based on literature data and carried out objectively, with no prejudices, to the best of the ability of the IARC Working Group, recognizing all the limitations, compromises, and uncertainties involved in describing such complex natural systems. Regarding the “evaluation of the exposure”, Volume 136 clearly report (page 52, line 10–14) that the description of the mines does not necessarily describe workers’ exposure or products derived from them.

The section on page 7, 4.1.4. *Asbestos and asbestiform* by Korchevskiy and Wylie (2025) is a key point of discussion and source of misunderstanding. In fact, the controversy and

different view of Korchevskiy and Wylie (2025) with respect to the IARC v.136 Working Group on the mineralogy of talc mostly concern the definition of “asbestos” (which may contaminate talc samples). This is a well-known, crucial and unresolved issue as there is no universally accepted definition of “asbestos” to date. Korchevskiy and Wylie (2025) give their own definition of “asbestos”: “a commercial term defining six minerals: chrysotile, grunerite (amosite), tremolite, anthophyllite, riebeckite (crocidolite), and actinolite in their asbestiform habit of formation”, relying on the term “asbestiform” as “...naturally occurring, poly-filamentous growth habit of minerals in which fibers are formed of parallel fibrils (single crystals) in bundles that can be separated into smaller fibers and fibrils with hand pressure. Asbestiform minerals are flexible in hand samples and fibers have higher tensile strength than other habits of the same mineral”. Korchevskiy and Wylie (2025) apply the term “asbestiform” to (hand-tested) macroscopic properties that may not extend to the microscopic scale, the level at which fiber respirability—and therefore carcinogenicity—is determined. On page 50 of the Volume 136, the Working Group instead defines “asbestos” “as a generic term applied to the (fibrous) asbestiform variety of serpentine (chrysotile) and the (fibrous) asbestiform variety of amphibole group minerals (anthophyllite, amosite (cummingtonite-grunerite), tremolite, actinolite, and crocidolite (riebeckite)), which have been exploited, prospected, described in the literature, traded, and sold commercially for their unique physical properties that result from the fibril width of $\leq 0.5 \mu\text{m}$ ”. Any fiber (not necessarily asbestiform) of one of the six asbestos minerals can be classified as “asbestos”. For example, a tremolite particle showing elongate(d) “fibrous” shape with length greater than $5 \mu\text{m}$ and width smaller than $3 \mu\text{m}$ can be classified as “asbestos”. With the macroscopic criteria considered by Korchevskiy and Wylie

(2025), it is impossible to apply the term “asbestiform” to that tremolite “asbestos” particle. As a matter of fact, classification of regulated (respirable) carcinogenic fibers is based on their (fibrous) shape and size (particle length $L \geq 5 \mu\text{m}$ long, particle width $W < 3 \mu\text{m}$, and aspect ratio $L:D \geq 3:1$: WHO 1997) and not on whether they are asbestiform. As example, Figure 1 depicts a FEG-SEM picture (and relative EDS) of an uncoated crocidolite fiber that was retained for ca. 40 years in the lungs of a subject diagnosed with malignant mesothelioma (Giacobbe et al. 2021). Although it does not meet the definition of “asbestiform” proposed by Korchevskiy and Wylie (2025) (“... poly-filamentous growth habit of minerals ... can be separated into smaller fibers and fibrils with hand pressure ... flexible in hand samples and fibers have higher tensile strength than other habits of the same mineral”), that killer fiber is one of the six asbestos minerals and has a length $\geq 5 \mu\text{m}$ and a width $< 3 \mu\text{m}$: it is therefore classified as “asbestos” under the definition adopted in IARC Volume 136. Apparently, this is a subtle difference but it is the key reason for the disagreement on the definition of “asbestos”. Much of the disagreement points (“the multitude of errors in Table 1.1” as stated by Korchevskiy and Wylie 2025) stems from the different understanding and use of the term “asbestos”.

On page 8, 4.1.5. *Amphibole asbestos in talc ores*, Korchevskiy and Wylie (2025) report that “uncertainty and confusion about whether or not an occurrence of amphibole asbestiform or nonasbestiform is evident in Table 1.1”. It is not a matter of “asbestiform” or “nonasbestiform” but of the presence of amphibole asbestos or not. As explained above, it was assumed that if a tremolite, actinolite, anthophyllite amphibole has not been described in the literature for that area as “asbestiform”, this does not mean it is not “asbestos” because the amphibole in question may be fibrous and have

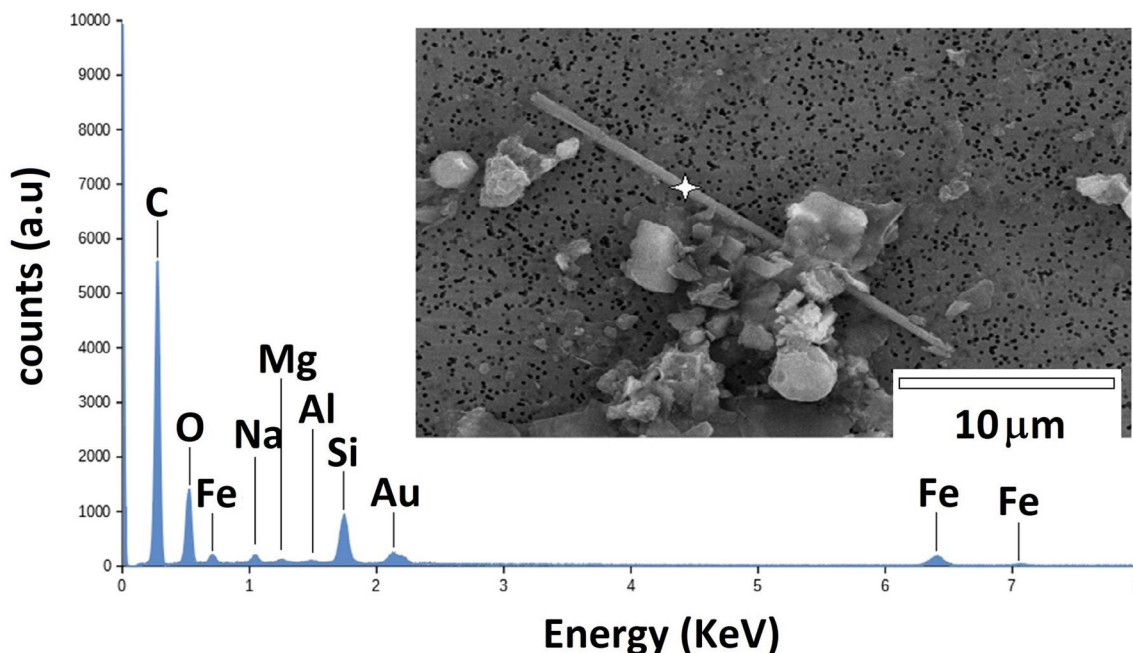


Figure 1. FEG-SEM-EDS picture of an uncoated crocidolite fiber that was retained for ca. 40 years in the lungs of a subject diagnosed with malignant mesothelioma (Giacobbe et al. 2021). Although it is not considered “asbestiform” under the definition of Korchevskiy and Wylie (2025), that killer fiber is one of the six asbestos minerals and has a length $\geq 5 \mu\text{m}$ and a width $< 3 \mu\text{m}$. It is therefore classified as “asbestos” according to the definition used in IARC Volume 136.

characteristics that identify it as “asbestos”. This explains “How the presence of nonasbestiform amphibole makes asbestos ‘Probable’” (Korchevskiy and Wylie 2025).

On page 8, 4.1.5. *Amphibole asbestos in talc ores*, Korchevskiy and Wylie (2025) also report that “Furthermore, there is no justification given for the idea that the surrounding rock formations are processed with the ore and enter a talc product”. In Volume 136, footnote of Table 1.1, it was actually written that “the presence of tremolite has been reported for the geological formation forming the deposit or in contact with the deposit”. The author remarks that “Forming” or “in contact” is not synonymous of “surrounding”.

On page 8, 4.1.5. *Amphibole asbestos in talc ores*, following the above discussion, Korchevskiy and Wylie (2025) postulate that “... probable that asbestos is present when the minerals are reported in a nonasbestiform habit is not justified (or justifiable) and the ideas that amphibole or serpentine near a talc deposit make chrysotile or amphibole asbestos probable in talc ore is not geologically sound”. Again, the term “asbestiform” and “nonasbestiform” have a different meaning for the classification used in Table 1.1. Moreover, it is questionable and imprudent to overlook the presence of amphibole or serpentine (eventually present as asbestos) near a talc deposit because the geometry of mineral ores, especially metamorphic rocks (e.g. serpentine) and products of metasomatism/metamorphism, can be very complex, with intercalations and contacts of various kinds that are often impossible to define, predict, and map. There are countless examples. Let’s take the case of the Nkob talc deposit in Moroccan Anti-Atlas described by Chatir et al. (2022). The talc layers in the ore are intercalated to green marble. Millimetric chrysotile veins (asbestos contamination) are observed in green marbles west of the deposit, in contact with the granite intrusion. Figure 2 shows a geologic section of the Nkob talc deposit with the potential mining area (area marked in green) and the chrysotile rich area (area marked in red). The simplified diagram evidently shows the overlap between the cultivated area and the asbestos contaminated area, and the very real possibility that some of the material extracted from the marginal areas near the granite intrusion may be contaminated with asbestos. For these reasons, the possible presence of asbestos in rocks near or in contact with the mined levels must be carefully evaluated because it is

impossible to rule out contamination during the exploitation and mining operations (e.g. blasting) of the peripheral parts of the ore.

On page 9, 4.1.6. *Chrysotile in talc ore*, Korchevskiy and Wylie (2025) report that “If the presence of chrysotile is not qualified as ‘Possible’ or ‘Probable,’ we assume that chrysotile asbestos has been reported in the ore body by the reference provided”. This is another major point of misunderstanding. Korchevskiy and Wylie (2025) made a wrong assumption as the references reported for each site in Table 1.1 are not intended to prove the presence of asbestos minerals but simply to give a reference to the geology and mineralogy of that site.

On page 10, column 2, lines 3–9 from the bottom, Korchevskiy and Wylie (2025) state that “Our review of all the references listed by IARC, as supporting the data in Table 1.1, shows that chrysotile has not been identified as a component of talc ore”. For the reasons specifically reported below (see section “Specific comments”), data reported in Table 1.1 hold and this statement is discarded.

On page 10, column 2, line 1 from the bottom, Korchevskiy and Wylie (2025) state that “From an understanding of mineralogy and petrology, it is not surprising that chrysotile is absent from talc ore. One common way mineral talc forms in nature is from the loss of water on heating serpentine... As serpentine is transformed and talc is formed, chrysotile, a form of serpentine, would not selectively resist this transformation based on anything we know about the behavior of minerals”. Korchevskiy and Wylie (2025) describe just “one way talc forms in nature”. There are many other processes (e.g. retro-metamorphism, secondary serpentinization, secondary alteration) through which talc formation may finally result in an association with serpentine (e.g. chrysotile). Talc formation has been schematically described in the Volume 136, page 51 and especially talc-chlorite genesis may display association of talc and serpentine minerals, including chrysotile. Just few examples are:

- i. Chrysotile in talc matrix within the chlorite talc ore type of Central Eastern Desert, Egypt—Gebel El-Maiyit (serpentinite-hosted talc/talc-carbonate; alteration of serpentinite) (Salem et al. 2025);

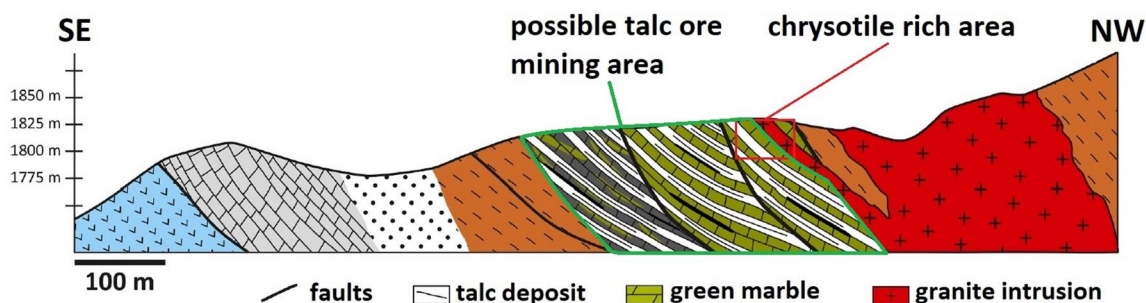


Figure 2. Geologic section Nkob talc deposit in Moroccan anti-Atlas described by Chatir et al. (2022). The talc layers in the ore (black lines within white areas) are intercalated to green marble (blocky green areas). Asbestos is observed in green marbles west of the deposit, in contact with the granite intrusion (crossed red areas). The potential mining area (area marked in green) and the asbestos (chrysotile) rich area (area marked in red) overlap and it is highly probable that some of the material extracted from the marginal areas near the granite intrusion may be contaminated with asbestos (modified from the original picture by Chatir et al. 2022).

- ii. Formation of talc overprinting chrysotile in a matrix of carbonated serpentinite in Cabo Ortegal ultramafic complex, NW Spain (serpentinite → carbonated serpentinite → talcose rocks) (Pereira et al. 2025);
- iii. Chrysotile, in association with tremolite, glaucophane, chlorite, talc, pyroxene, and feldspar, occurs as a result of alteration of metamorphic and ophiolitic units by an acidic hydrothermal process in the Eskis,ehir region, western Turkey (Kadir and Erkoyun 2015);
- iv. Mineralized veins fillings containing chrysotile and talc, with carbonates and other phases are observed in the serpentinite quarries in Valmalenco, Central Alps, Northern Italy (Cavallo 2020).

On page 11, 4.1.7. *General comments*, Korchevskiy and Wylie (2025) state that “IARC concludes that ‘asbestos is a common contaminant of talc’ (136), and throughout the document, IARC expresses ‘concern about asbestos contamination’ in interpreting evidence, including which studies to include or exclude based on this concern. The conclusion that asbestos is a common contaminant is not supported by the data given for the major talc deposits of the world in Table 1.1 ...” Data reported in Table 1.1 (see section “Specific comments”) definitely support the observation that asbestos can be a common contaminant of talc and the IARC v.136 Working Group believes that concern about asbestos contamination of talc should not be disregarded.

On page 11, 4.1.7. *General comments*, Korchevskiy and Wylie (2025) state that “It is questionable how IARC was able to characterize available toxicological information from the literature, clearly distinguishing all possible combinations of various categories of talc when their compilation of the mineralogy of the talc sources was so flawed”. The mineralogical (unflawed) data were useful to the members of the Working Group but did not necessarily described workers’ exposure or products derived from those mining areas.

On page 11, 4.1.7. *General comments*, Korchevskiy and Wylie (2025) state that “Table 1.1 of the recent monograph show that unbiased characterization of all available studies is complicated and conclusions made by IARC on pure talc carcinogenicity lack mineralogical meaning”. Volume 136 clearly defines “pure talc” and the other talc products (page 48–49) and reports when talc is (possibly or probably or certainly) contaminated by asbestos. Hence, this sentence appears to be arbitrary and not supported by sound scientific ground. On the same line, on page 11, 4.1.7. *General comments*, Korchevskiy and Wylie (2025) also remark that “The IARC definition of ‘pure talc’ is qualitative, and there appears to be no attempts in Monograph 136 to distinguish between cosmetic and industrial talc, or to set up an analytical threshold to specify the purity of talc. It is unclear if in the case of industrial talc whether IARC was able to determine if ‘fibrous talc’ (not considered to be asbestos) could be present in some of the tested samples and what impact could be expected from this component on the toxicity of talc”. As said above, the definitions of pure, industrial and cosmetic talc are clearly reported on page 48–49 of Volume 136. IARC Working group did not assess if “fibrous talc” (not considered to be asbestos) could be present in the samples and what impact could be

expected from this component on the toxicity of talc as this is a very rare, incidental, and industrially negligible form of talc and there are no specific data on its toxicity/carcinogenicity. The author recognizes that this topic would be well suited for a future independent and unbiased experimental study.

Specific comments

In this section, the author discusses all the specific issues raised by Korchevskiy and Wylie (2025), which, according to them, invalidate the description of talc mineralogy reported in Table 1.1 of Volume 136.

Section 4.1.5 Amphibole asbestos in talc ores

1. *Afghanistan, Nangarhar Province*. Korchevskiy and Wylie (2025) report that “While tremolite is discussed by Tahir et al. (2018), and they describe in detail the habit of many elongate minerals, including use of the term fibrous, they do not use the terms asbestiform or asbestos to describe tremolite. In mineralogical terminology and by IARC’s own terminology, fibrous is not a synonym for asbestiform”. As explained in the previous section, on page 50 of Volume 136 “... Here we define ‘asbestos’ as a generic term applied to the (fibrous) asbestiform variety of serpentine (chrysotile) and the (fibrous) asbestiform variety of amphibole group minerals (anthophyllite, amosite (cummingtonite-grunerite), tremolite, actinolite, and crocidolite (riebeckite) ...” and “asbestos” can also be defined as “fibrous” particle and not just “asbestiform”.
2. *Brazil, Bahia, District*. Korchevskiy and Wylie (2025) report that “IARC (2025) relied on Gondim and Jiang (2004) for the mineralogy of the Bahia district of Brazil. Both actinolite asbestos and tremolite asbestos are listed as present in the mines. However, Gondim and Jiang do not mention amphibole asbestos occurring in any of the mines”. As explained in the previous section, Korchevskiy and Wylie (2025) made the erroneous assumption that the references reported for each site in Table 1.1 are intended to prove the presence of asbestos minerals. The reference Gondim and Jiang (2004) is reported here to describe the geology and mineralogy of the Bahia district (and not specifically the Bahia talc mines!). The presence of fibrous actinolite-tremolite (“asbestos”, according to our definition) is well described for the Bahia district (see e.g. Santos and Menezes Leal 2022, who report that “... It was not possible to separate tremolite from actinolite without the aid of mineral chemistry” as “They occur as fibrous crystals ...”).
3. *Canada, Madoc, Ontario*. Korchevskiy and Wylie (2025) report that “At Madoc, Ontario Canada, IARC lists tremolite asbestos and references Sabina (1987). However, Sabina does not report amphibole asbestos from this mine”. The author contends Korchevskiy and Wylie (2025) observation because Table 1.1 correctly reports “tremolite, actinolite possible”, following the statement

on page 31 of Sabina (1987): “tremolite ... occurs as light green prismatic and fibrous aggregates” in Henderson and Conley talc mine. Since the fibers are green, they are “possibly” an iron-rich term in the actinolite-tremolite series. Moreover, in the GLOSSARY section, Sabina (1987) clearly reports that actinolite is “fibrous” (page 126), tremolite is “fibrous” (page 136), and that “Amphibole-asbestos” is the “fibrous variety of amphibole e.g. tremolite, actinolite, ...”.

4. *India, Rajasthan.* Korchevskiy and Wylie (2025) report that “In the talc mines in Rajasthan, India, IARC lists tremolite asbestos. The reference, Shekhawat et al. (2010), does mention that tremolite asbestos exists in the same geographic area, but it is not reported as associated with talc”. The observation of Korchevskiy and Wylie (2025) is apparently incorrect because Shekhawat et al. (2010) not only remark that amphibole asbestos of the area is tremolite (page 464) but clearly state that “... talc is also present in association with tremolite where it occurs as interfiber space fillings in the form of fibrous aggregates (Figure 4E, page 466) indicating its co-genetic relationship with tremolite” (page 467).
 5. *Korea, Dongyang, Chungju.* Korchevskiy and Wylie (2025) report that “... IARC relies on Dongbok et al. (2004) for the conclusion that tremolite asbestos occurs there, but these authors do not describe asbestiform tremolite nor mention tremolite asbestos”. The observation of Korchevskiy and Wylie (2025) is apparently incorrect because Figure 1 (page 359) in the paper of Dongbok et al. (2004) clearly shows that tremolite is fibrous-asbestiform.
 6. *Norway, Altermark, Rana.* Korchevskiy and Wylie (2025) report that “... IARC asserts that both anthophyllite asbestos and tremolite asbestos accompany the ore. They rely on Karlsen et al. (2000), Wergeland et al. (1990), and Wergeland et al. (2017). These authors say that amphibole occurs in trace amounts, but there is no discussion of the amphiboles as asbestos or asbestiform”. The observation of Korchevskiy and Wylie (2025) is apparently incorrect because Wergeland et al. (2017) clearly report (page 821) that “Their study was initiated in 1981 because the National Institute of Occupational Health (NIOH) in Norway had identified tremolite and anthophyllite (asbestiform fibers) in bulk samples from the (talc) mine”.
 7. *USA, Georgia, Chatsworth District, Murray County.* Korchevskiy and Wylie (2025) report that “In the Chatsworth district, Murray County, Georgia, IARC lists the presence of actinolite, anthophyllite and chrysotile asbestos. Their reference, Furcron et al. (1947), does not mention anthophyllite in the ore, although it is mentioned in surrounding rocks, and actinolite is only mentioned once as occurring in white grinding crayon. There is no mention of asbestos or the asbestiform habit of these amphiboles”. The observation of Korchevskiy and Wylie (2025) is apparently incorrect because Furcron et al. (1947) report “... chrysotile (asbestos), ... amphibole (a) actinolite, (b) anthophyllite; ...” for the Murray County talc deposits (page 38). Moreover, the presence of “asbestiform minerals” including actinolite is known since 1914 for the Chatsworth talc deposits (page 85–86: Hopkins 1914).
1. *Allamoore talc District.* Korchevskiy and Wylie (2025) report that “In the Allamoore talc district, IARC relied on Van Gosen et al. (2004) for their conclusion that talc deposits in the district contain tremolite asbestos. In fact, Van Gosen asserts that there is no tremolite in the talc mines”. As explained above, Korchevskiy and Wylie (2025) misinterpreted the meaning of the references reported for each site that describe that specific occurrence and not aimed to prove the presence of asbestos. It is true that Van Gosen et al. (2004) does not report asbestos there but Greene (1995) does: “Most of the talc deposits are in the Allamoore Formation. ... Quartzite and dolomite are interbedded with the phyllite; magnesite and tremolite, some of the latter asbestiform, are also locally present, but calcite is absent”. The presence of tremolite in the Allamoore District is also confirmed by Rohrbacher (1973) who claim that (page 7) “Blue alkali amphibole and tremolite-actinolite occur in rocks within and near talc bodies in some areas”. For the Allamoore District, Wylie and Huggins (1980) curiously report that “The habit of the potassian winchite-asbestos has all the characteristics of commercial asbestos. The fibers are silky, flexible, and have good tensile strength. The fibril size and bundle structure are similar to those of crocidolite, grunerite-asbestos, tremolite-asbestos, actinolite-asbestos”.
 2. *China, Guangxi Province.* Korchevskiy and Wylie (2025) report that “Schober (1998) does report tremolite from Shandong province, but not Guangxi”. The observation of Korchevskiy and Wylie (2025) is apparently incorrect because Schober (1998) states (page 59): “... mines in Liaoning, Shandong and Guangxi are set in this environment. The accompanying minerals found are magnesite, ..., calcite, in some cases also tremolite, and pyrites”. This fully justifies the prudent claim on Table 1.1 of “Tremolite possible”.
 3. *China, Liaoning (not Liang) Province.* Korchevskiy and Wylie (2025) report that “IARC (2025) relied on Misch et al. (2018) for their conclusion that tremolite is possible, but Misch et al. report tremolite only from a magnesite mine, not a talc mine”. The observation of Korchevskiy and Wylie (2025) is apparently incorrect because Misch et al. (2018), for Liaoning, report (page 2): “It hosts large magnesite and talc deposits of excellent quality (Haicheng-Dashiqiao talc and magnesite ore belt; Figure 3) as well as serpentine jade deposits and other Mg-bearing minerals (e.g. tremolite)”. Moreover, as said above, Schober (1998) actually states that (page 59): “... mines in Liaoning, Shandong and Guangxi are set in this environment. The accompanying minerals found are magnesite, ..., calcite, in some cases also tremolite, and pyrites”. Again, there is enough evidence to justify the careful claim on Table 1.1 of “Tremolite possible”.
 4. *Italy, Sa Matta, Sardinia.* Korchevskiy and Wylie (2025) report that “Fiori and Grillo (2002) do not report

tremolite in the ore at Sa Matta, Sardinia, Italy, yet IARC relies on them to say that tremolite in the ore is probable. They do report a recent discovery of a carbonate containing tremolite adjacent to the ore body". The observation of Korchevskiy and Wylie (2025) is apparently incorrect because Fiori and Grillo (2002) clearly report that "A recently developed open pit mine has exposed both exposed both metalimestones and metadolostones in direct contact with the chlorite-talc mineralised zones. A mineralogical study of the newly exposed rocks has shown the presence of a complex mineral paragenesis consisting of talc, Mg-chlorite, magnesite, garnet, tremolite and sillimanite".

5. *USA, California, Inyo, Northern Panamint Range.* Korchevskiy and Wylie (2025) report that "... IARC says that tremolite asbestos is probable and relies on Greene (1995), who does not mention tremolite or quartz and says these deposits lack minerals other than talc". The observation of Korchevskiy and Wylie (2025) is inaccurate because, for the Panamint Range, Greene (1995) reports "Talc is accompanied by tremolite, chlorite, minor iron oxides, and residual carbonate minerals" (page 34). Hence, "probable tremolite" was correctly reported for this area.
6. *USA, (Montana) Dillon-Ennis District, Yellowstone (mine).* Korchevskiy and Wylie (2025) report that "IARC relies on Van Gosen et al. (2004) to conclude that tremolite is probable in the Dillon-Ennis district Yellowstone mine. In fact, Van Gosen et al. (2004) and another reference relied on by the IARC v.136 Working Group, Buzon and Gunter (2017), also conclude that there is no tremolite in this mine". Korchevskiy and Wylie (2025) misinterpreted the information reported on Table 1.1 because they seem to refer to the **Yellowstone (mine)** only while the assignment "Tremolite (is) probable" refers to the whole Yellowstone area, including that mine site, and not just to the Yellowstone mine. This assignment is justified by the Buzon and Gunter (2016) statement that "The occurrences of tremolite in close proximity to the mineable bodies represent higher-grade metamorphic conditions" (page 71). The mine samples analyzed by Buzon and Gunter (2016) were likely "nearly monomineralic", given that they were provided directly by the mining company (the authors explicitly thank Imerys Talc and Barretts Minerals for supplying the samples) and would therefore be expected to represent highly quality-selected material.
7. *USA, Montana, Dillon Ennis District, Willow Creek, and Beaverhead mines.* Korchevskiy and Wylie (2025) report that "IARC relies on Van Gosen et al. (2004) to conclude that tremolite is probable from the Willow Creek and Beaverhead mines in the Dillon Ennis district of Montana. In fact, Van Gosen et al. does not mention these two mines specifically but conclude that the district is amphibole free. This is supported by Buzon and Gunter (2017)". As explained above, even for this occurrence, Korchevskiy and Wylie (2025) misinterpreted the meaning of the references reported for each site that are actually intended to describe that specific occurrence

and not to prove the presence of asbestos minerals. For this area, in Table 1.1, it was prudently indicated "Tremolite probable" because Berg (1979) reports (page 11) tremolite at "Ruby Peak occurrence", inside the "Ruby Range" area which hosts both Willow creek and Beaverhead talc deposits.

8. *Finland, Polvijarvi, Sotkamo, and Vuonos mines.* Korchevskiy and Wylie (2025) report that "IARC relies on Kuutila (2022) to conclude that tremolite is probable from both the Sotkamo and Vuonos mines in Polvijarvi, Finland. Kuutila wrote about sulfide mineralization in Finland, not talc, and while talc was mentioned, talc mines were not described. Sotkamo was not mentioned at all and Vuonos was described as a Cu, Zn, Co deposit. Another source, not consulted by IARC, describes many talc mines in Finland generally (Vesasalo 1965)". Table 1.1 reports "Tremolite probable" for the **Finland, Polvijarvi, Sotkamo and Vuonos** area because it is part of the so-called "Outokumpu assemblage". Evidence of tremolite is reported by Kuutila (2022) who clearly states that "The deposits (of metals) are associated with ophiolites and enclosed in what is called Outokumpu assemblage" (page 5) and that "There are currently four talc mines in the area as well, according to GTK's Mineral deposits and exploration database" (page 9). Moreover, *mindat* database lists tremolite as occurring at the Sotkamo talc deposits, including the Lahnaslampi talc deposit (www.mindat.org/loc-16566.html).
9. *Brazil, Bahia district.* Korchevskiy and Wylie (2025) report that "Gondim and Jiang mention chrysotile only in association with vermiculite and Archean granulite basement rocks, not associated with major talc ores, and provide no reference or data to support the identification of chrysotile". Korchevskiy and Wylie (2025) misjudged the sentence of Gondim and Jiang (2004) on page 831 reporting that "The talc deposits hosted in Archean granulitic basement are associated with vermiculite mineralization and some deposit also contain chlorite and chrysotile".

Section 4.1.6 Chrysotile in talc ores

1. *Brazil, Paranà district, Ponta Gross, and Castro mines.* Korchevskiy and Wylie (2025) report that "Gondim and Jiang do not mention chrysotile although they do indicate serpentine (antigorite) can be found in the ore". It is true that various polymorphs of serpentine (namely antigorite) are reported in the area (see for example, Brindley and Persio de Souza 1971) but there are papers pointing to chrysotile (Saunite et al. 2011, in Portuguese): "O metamorfismo termal relacionado ao enxame de diques de diabásio do Arco de Ponta Grossa gerou nos metadolomitos bandas irregulares de granulação muito fina, de cor preta, castanha e verde, contendo serpentina. Megaxenólitos de metadolomito em diques espessos contêm crisotila, em parte pseudomorfa sobre olivina, e veios de brucita". This justifies the report on Table 1.1 of "Chrysotile probable".

2. *China, Liaoning Province.* Korchevskiy and Wylie (2025) report that “Misch et al. (2018) were relied on to conclude that the industrial talc deposits of Liaoning Province, China, have ‘probable chrysotile ... (IARC 2025). However, the reference does not mention chrysotile at all, only mentioning serpentine as the source of jade deposits and not as a component of the ore’”. Misch et al. (2018) actually report (page 18) that “In the eastern Liaoning Province, the Mg-rich metallogenic system shows major talc-, magnesite-, and boron-deposits as well as different other Mg-rich minerals like serpentine (Zhai et al. 2004)”. Talc mineralization are associated to serpentine minerals there and fibrous serpentine (chrysotile) deposits are well documented in Liaoning Province, including in published Chinese literature discussing asbestos mineralization and in locality records for an asbestos mine in Chaoyang County. Association of talc, chrysotile, lizardite, and tremolite at localities like Beiwagou and Bianning within the Liaoning province, indicating geological association of asbestos-group minerals with talc-bearing units is reported (www.smartminerals.com/cina2004/art_China_localities.htm) even though some mining companies operating in Liaoning’s Liaonan talc deposit claim that their talc has no asbestos or heavy metals, indicating that certain ores have been tested free of detectable asbestos. It is believed that this body of information justifies the report on Table 1.1 of “Chrysotile probable” for this occurrence.
3. *India, Rajasthan.* Korchevskiy and Wylie (2025) report that “IARC states that chrysotile is possible in the Rajasthan district based on Shekhawat et al. (2010). However, Shekhawat et al. only mention chrysotile in massive serpentinite, not in talc ore”. Serpentinite rocks are associated to talc deposits. For this reason, Table 1.1 prudently reports “Chrysotile possible” for this occurrence. The association of talc with chrysotile in Rajasthan area is well documented. For example, a remote-sensing and geology study of the Rishabdev ultramafic suite, in Rajasthan, reports serpentine-group minerals including “lizardite, antigorite, chrysotile” and that the associated alteration products include “talc and dolomite” (Hrishikesh Kumar and Rajawat 2020). This is the ultramafic serpentinization/carbonation pathway where talc forms as an alteration product of serpentine, and the study explicitly names chrysotile among the serpentine minerals mapped alongside talc as an alteration product.
4. *Italy, Valmalenco.* Korchevskiy and Wylie (2025) report that “At Valmalenco, Italy, Cavallo and Petriglieri (2020), the source relied upon by IARC (2025), only mentions chrysotile as veins in serpentinite mined for building stone, not in talc ore. Serpentine is not reported as a component of talc ore”. The observation of Korchevskiy and Wylie (2025) is apparently incorrect because Cavallo and Petriglieri (2020) state that: “... these rocks are cut by talc and chrysotile lodes and veins, related to the late phases of the orogenic event, at low to very low temperature and high-fluid activity recrystallization conditions (Ulmer and Trommsdorff 1995)” and “Steatite (impure talc, with small amounts of serpentine, chlorite and magnesite) is also actively mined in the area”. Chrysotile exists in the same serpentinite geology as the talc ore in Valmalenco. The serpentinite bodies with chrysotile veins and the talc ore bodies are not distant, unrelated rock types as spatially and genetically they are part of the same metamorphic suite. The presence of chrysotile in mine dumps, veins, and serpentinite bodies adjacent to talc workings is well documented (Cavallo 2020). These references fully justify the report on Table 1.1 of “Chrysotile probable”.
5. *Sweden, Handöl Koli, Asan.* Korchevskiy and Wylie (2025) report that “IARC relies on Bergman (1993) to conclude that chrysotile in the ore is probable. While serpentine is found in talc schists in the area, chrysotile is not mentioned. Furthermore, this reference does not discuss talc mines”. As explained above, even for this occurrence, Korchevskiy and Wylie (2025) misinterpreted the meaning of the references reported for each site intended just to describe the mineralogy/geology of the site. For this area, Table 1.1 reports “Chrysotile probable” because *mindat* database explicitly describes chrysotile at the Handöl talc/soapstone locality. In fact, on the *mindat* locality page “Handöl, Åre, Jämtland County, Sweden”, the description identifies it as a “Soapstone quarry, serpentinitized ultramafic rocks”, and the mineral list for that same locality includes both chrysotile and talc (Mindat.org. Handöl, Åre, Jämtland County, Sweden—Locality ID 13581).
6. *USA, Georgia, Chatsworth district, Murray County.* Korchevskiy and Wylie (2025) report that “... if (Furcron et al. 1947) were identifying chrysotile as a component in a talc ore, then this conclusion is questionable. The three forms of serpentine were not identified until 1956, nine years after the Furcron et al. paper, when Whittaker and Zussman (1956) published the first determinative data for the serpentine polymorphs”. The observation of Korchevskiy and Wylie (2025) is incorrect because the structure of the serpentine polymorphs, including chrysotile was known since 1931. In fact, the earliest outstanding paper that actually describes the crystal structure of chrysotile (serpentine asbestos) is by Warren and Bragg (1931) who open their paper by saying that: “Chrysotile is a member of the serpentine group...”. After 1931, another milestone paper on the crystal-structure of serpentine polymorphs has been published by Whittaker (1953).
7. *USA, Maryland, Piedmont Belt.* Korchevskiy and Wylie (2025) report that “IARC relied on Cleaves et al. (1974) and Greene (1995) for the mineralogy of this set of small talc deposits. Neither Green nor Cleaves mentions chrysotile and Cleaves does not discuss talc deposits”. Once again, Korchevskiy and Wylie (2025) misinterpreted the meaning of the references reported for each site, intended just to describe that specific occurrence. Chrysotile associated to the serpentine rocks and talc deposits of the Maryland Piedmont Belt is well documented in the literature. For example, Puffer et al.

(1980) investigated the asbestos content of 18 abandoned and active serpentine, gravel, and talc quarries/mines in the Maryland Piedmont Belt district and invariably report that fibrous serpentine (chrysotile) is associated to talc (Table 2, page 238). As a matter of fact, Cleaves et al. (1974) in their paper report “Chemical analyses of serpentine minerals and serpentinite from various Maryland serpentinite areas ...” and cite the work of Nagy and Faust (1956) who, in turn state that (abstract) “Chemical, physical, and mineralogical investigations show that the serpentine group of minerals are natural mixtures of various proportions of the two ‘end-members’, chrysotile and antigorite”. Hence, Table 1.1 prudently reports “Chrysotile possible” for this area.

8. *USA, New York, Gouverneur district, St. Lawrence County, Fowler.* Korchevskiy and Wylie (2025) report that “IARC relied on a number of sources for the mineralogy of this complex talc district including Wylie et al. (1997), IARC (2010), Van Gosen et al. (2004), and Gunter et al. (2018) to conclude that chrysotile is possible. None of the references support the presence of chrysotile”. Even in this case, Korchevskiy and Wylie (2025) misinterpreted the meaning of the references reported for each site, which were intended solely to describe the specific occurrence. Serpentine is certainly present in the Gouverneur district (Gunter et al. 2018). *Mindat* database confirms that “serpentine subgroup” (which may include chrysotile) are present at the Gouverneur district, St. Lawrence County, Fowler talc area (www.mindat.org/loc-20720.html). Moreover, in their study of seven samples from the Gouverneur Talc Company, Dement and Zumwalde (1976) detected “trace quantities of chrysotile in 2 of the 7 samples” (ca. 28%). Hence, all these observations fully justify the prudent claim on Table 1.1 of “Chrysotile possible”.
9. *USA, New York, Lewis County, Natural Bridge.* Korchevskiy and Wylie (2025) report that “IARC relies on Van Gosen et al. (2004) who do not mention Natural Bridge nor does IARC (2010), another reference. Engel (1949) describes the mineralogy but does not mention chrysotile”. Again, Korchevskiy and Wylie (2025) misinterpreted the meaning of the references reported for each site, which were intended solely to describe the specific occurrence and not to demonstrate the presence of asbestos. It is true that Van Gosen et al. (2004) does not report asbestos there but, contrary to what Korchevskiy and Wylie (2025) stated, Engel (1949) does cite fibrous serpentine (chrysotile) in Table 1 (page 347). Moreover, *mindat* database also reports chrysotile in the talc mine area of New York, Lewis County, Natural Bridge (www.mindat.org/loc-9600.html). These references fully justify the claim on Table 1.1 of “Chrysotile possible”.
10. *USA, Texas, Llano district.* Korchevskiy and Wylie (2025) report that “IARC relies on Van Gosen et al. (2004) for the presence of chrysotile. Chrysotile is mentioned as a component of some ‘serpentine masses’, not as a component of the ore”. Chrysotile is not specifically mentioned for the talc ore but is present in the serpentine rich-area which are spatially and genetically related to the talc deposits. This postulation is confirmed by Chidester (1962): “A genetic relationship to serpentinite is clearly indicated for such deposits, but details of the mode of origin are not known”. In concert, Barnes et al. (1950) write that (page 11) “Soapstone is situated along the periphery of the serpentine mass in several places and occurs as inclusions within the serpentine either alone or associated with phases of the Packsaddle schist”, and draws a geology map (Figure 5, page 19) showing soapstone occurrences right in contact with the serpentinite rocks. For those rocks, Barnes et al. (1950) also state that “The mineral composition of the serpentine in thin section appears to be relatively simple, with antigorite (possibly including some chrysotile)”.
 11. *USA, Vermont (Blackwall) talc.* Korchevskiy and Wylie (2025) report that “To support the conclusion that chrysotile is present in the talc ore from Vermont, IARC relies on IARC (2010), Van Gosen et al. (2004), Gunter et al. (2018), and Egilman et al. (2020). Van Gosen et al. mention that chrysotile may be found in massive serpentinite but not in talc deposits. Gunter et al. report it possible to find antigorite in some mine products. IARC (2010) does not list serpentine as a component of the Vermont talc ores. The only reference to support chrysotile in talc is Egilman et al. ...”. Egilman et al. (2020) do report chrysotile in that ore, Van Gosen et al. (2004) observed that “Black-wall talc deposits are associated spatially with serpentinite masses that in some areas host well-developed chrysotile asbestos”, and Gunter et al. (2018) show the picture of an evident chrysotile bundle for the talc ore sample (!) (TEM data in Figure 17b, page 22), commenting that “the fibrous one shows one-dimensional streaking which is also seen in chrysotile by Millette in 2006 Gunter et al. (2018)”. These observations justify the claim on Table 1.1 of “Chrysotile probable” for USA, Vermont (Blackwall) talc.

Conclusions

Korchevskiy and Wylie (2025) allege inconsistencies and inaccuracies in the description of talc mineralogy presented in IARC Volume 136, which they argue could support the conclusion that the IARC re-classification of talc carcinogenicity represents a move in the wrong direction. This letter addresses all observations raised by Korchevskiy and Wylie (2025), providing detailed explanations intended to clarify and respond to the alleged issues.

Most points of divergence between Korchevskiy and Wylie (2025) and the IARC v.136 Working Group evaluation stem from differing interpretations of the definition of “asbestos”, as well as from a misunderstanding of the purpose of the references cited for each site in Table 1.1. The aim of those references was to describe the geological and mineralogical characteristics of each specific talc occurrence, rather than to demonstrate the presence of asbestos.

The author has provided references and explanations to support the data reported for the major talc deposits worldwide in Table 1.1 and in Volume 136, and to substantiate the concern expressed by the IARC Working Group regarding the potential for asbestos contamination in talc deposits around the world. As a mineralogist, the author is fully aware of the complexity of talc mineralogy, including issues related to mineral associations, particle morphology, and the relationships among individual mineral species. The data drawn from the literature and used to compile the table are inevitably fragmentary, often dated, and largely qualitative in nature; nevertheless, they are the result of an analysis conducted with the utmost care and with an objective and unbiased approach. While it cannot be excluded that errors may exist and that the analysis could be further improved, the author considers the current assessment to represent a solid foundation. Meaningful improvement would require a large-scale, systematic investigation involving the sampling and analysis of commercial talc from every mining area worldwide. Such an undertaking would be substantial in terms of time and resources, but it could definitively address remaining uncertainties for several critical talc mining regions. In the author's view, a project of this magnitude and importance should be undertaken by a team of internationally recognized, independent researchers.

In conclusion, Korchevskiy and Wylie contend that “the IARC re-classification of talc carcinogenicity” may have been “a move in the wrong direction”. However, their conclusions based upon the study of talc mineralogy are inaccurate and should not be construed to support their contention.

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Declaration of interest

The author declares to have no competing financial interests or personal relationships at all that could have appeared to influence the work reported in this letter. The preparation of the letter is motivated by the need to clarify issues raised by Korchevskiy and Wylie (2025) concerning the mineralogical characterization of talc presented in IARC Monographs Volume 136, and the implications of this characterization for exposure assessment and carcinogenicity. The letter provides a detailed, point-by-point clarification of key mineralogical aspects that are central to understanding the nature of the evaluated substance and addresses the alleged inconsistencies identified by Korchevskiy and Wylie (2025). The author did not receive any compensation at all or external assistance for the preparation of this letter. The staff of the International Agency for Research on Cancer (IARC)—World Health Organization reviewed the letter and approved its submission. The author has served as member of IARC Working Group for the evaluation of talc in 2024 and coauthor of the IARC Monographs on the Identification of Carcinogenic Hazards to Humans—Volume 136: Talc and Acrylonitrile. The author has never participated in, nor does the author anticipate participating in, any legal

(e.g. as an expert witness in litigation), regulatory, or advocacy proceedings related to the contents of the letter. The author is Full Professor of Mineralogy and was a member of IARC Working Group for the evaluation of talc in 2024 and coauthor of the IARC Monographs on the Identification of Carcinogenic Hazards to Humans—Volume 136: Talc and Acrylonitrile.

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